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Multiple use forest management and the possibility of its application in the developing countries

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MULTIPLE USE FOREST MANAGEMENT AND THE POSSIBILITY OF ITS APPLICATION IN THE DEVELOPING COUNTRIES

by

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INTRODUCTION

The developing countries are passing through a transitional phase of socio-economic development. Based upon their pastoral-agricultural economies, the new nations are endeavoring to attain a quasi-industrial infra-structure for economic development. In this effort, these countries are faced with a large number of problems which concern both human and material resources. Political instability, administrative weakness, lack of adequate financial and technological resources and cultural taboos are some of the serious obstacles hindering the progress of many under-developed countries.

The land, especially the forest, is a vital basic resource upon which the structure of economic development can be based. Unfortunately, the land resources in most of the developing countries have been heavily misused. Overgrazing, burning and clearance of forests for settlement, shifting cultivation, etc., have resulted in the deterioration of productive potential, and, in many cases, in the creation of deserts and seriously eroded areas. The problem facing these countries today is two-fold, namely, how best to rehabilitate the deteriorated resources, and utilize the comparatively undamaged resources in an efficient way. This problem has been made more complicated by the rapidly increasing human population, which naturally would cause a proportionately increasing pressure on the resources.

The forest manager in a developing country is faced with an enigmatic situation. As a trustee of an important resource, he is under obligation to perform his function in the developmental machinery

and introduce efficient management conforming to the overall national development. On the other hand, he has to cater to the traditional use rights and privileges of an overwhelmingly rural population. This calls for a management pattern which should meet the present needs and wants of the people and leave enough room for the accommodation of new demands which are likely to arise as the socio-economic situation improves.

Multiple use forest management may be an adequate answer to this enigmatic situation. This system was developed in an era when the United States of America was passing through a transitional stage of an economic revolution. It is elastic enough to meet the requirements of diverse situations. By no means is it an end in itself; but it is a better means to achieve a compromise between conflicting forest uses. In this paper, I shall endeavor to discuss the possibility of its application to under-developed countries.

Section I of this paper deals with the forest resources of the developing countries. Their socio-economic and forestry problems are discussed in Section II. The principles and practices of multiple use management are given in Section III. Effort has been made in Section IV to ascertain the possibility of the application of multiple use management to the forest resources of under-developed countries.

SECTION I

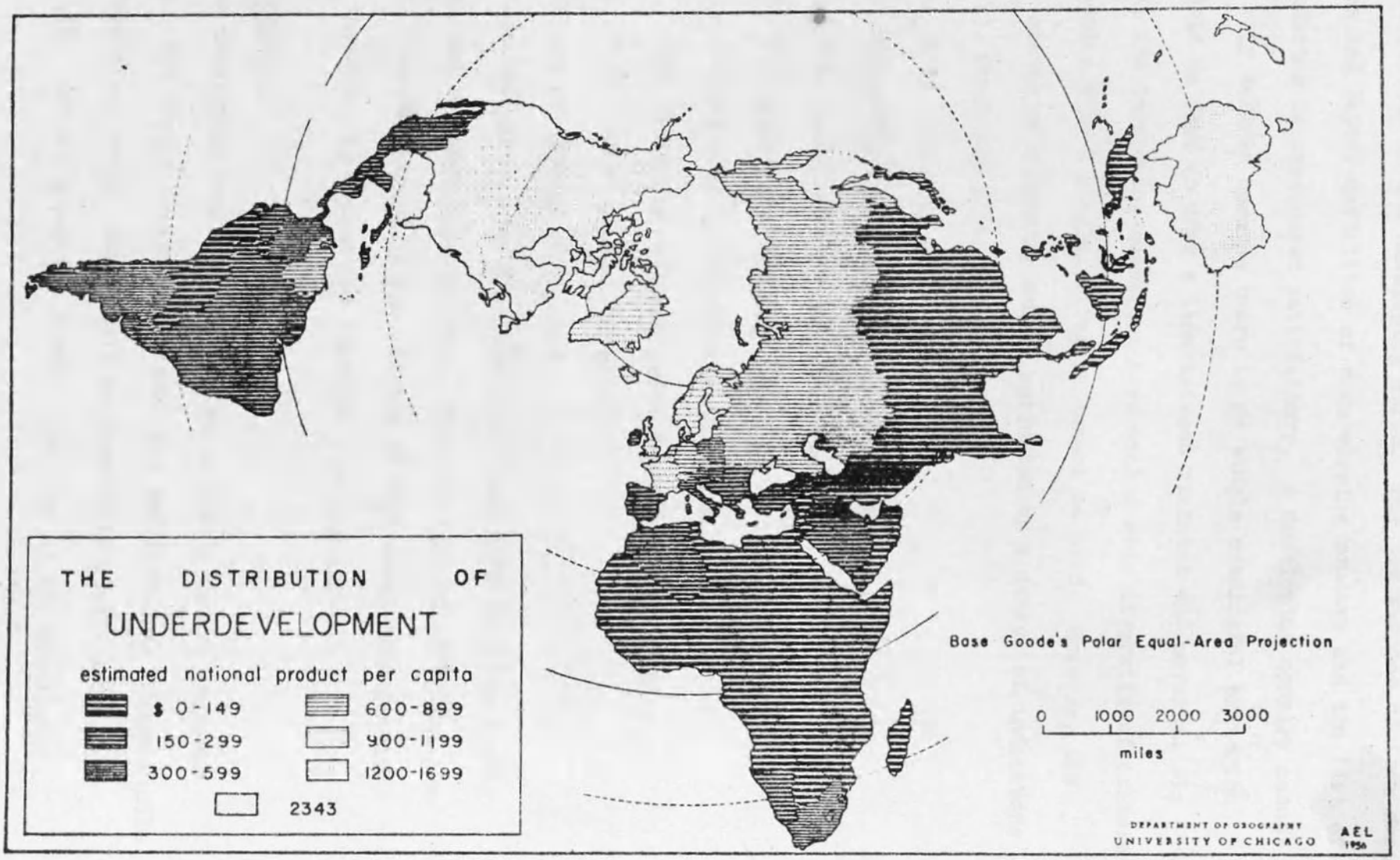
FOREST RESOURCES OF THE DEVELOPING COUNTRIES

Definition of a Developing Country

The under-developed, or the developing countries of the world contain 75 per cent of the world population and less than half of the land resources (54). Most of them have obtained political independence during the last 20 years. Their economies are predominantly pastoral and agricultural. With the exception of Australia, New Zealand and Union of South Africa, practically the whole of Asia, Africa and Latin America are in an under-developed stage. The numerous problems facing the human race today emanate from the under-developed world in one way or another. Yet these countries contain valuable resources, which, if properly developed, can make a remarkable contribution towards human welfare.

Before proceeding further, an acceptable definition of a developing country should be evolved. The United Nations agencies, such as F.A.O. and U.N.E.S.C.O., include in this category all countries and territories in Africa (except South Africa), North and South America (except Canada and U.S.A.), Asia (except Japan and Turkey) and Oceania (except Australia and New Zealand). The Organization of Economic Co-operation and Development, Paris, has included Greece, Spain, Yugoslavia, Malta, Gibraltar and Turkey in the U.N. list. This, however, leaves out China, Mongolia, North Korea and Vietnam. Moyes and Hayter (54) have included U.N. and O.E.C.D. lists plus China, Mongolia, North Korea and

MAP NO. 1.


THE DISTRIBUTION OF
UNDERDEVELOPMENT
estimated national product per capita
$ 0-149
150-299
300-599
600-899
900-1199
1200-1699
2343
Base Goode's Polar Equal-Area Projection
0 1000 2000 3000
miles
DEPARTMENT OF GEOGRAPHY
UNIVERSITY OF CHICAGO
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and North Vietnam in the developing world. For the purpose of this paper, the Moyes and Hayter definition of a developing country and the list of such countries is considered satisfactory. A developing country cannot be precisely defined because there is no single meaningful criterion which could be used to draw a line between richness and poverty. In addition, the developing countries have such a wide diversity of culture and economics that a single criterion cannot be used. However, the economic status of a country can be estimated by a number of indicators (54, p. 1), which are given below:

a. A low real income per head

b. Dependency on one or two crops or minerals

c. Abnormally used natural resources

d. Widespread unemployment

e. Abundance of labor compared to capital equipment

f. High proportion of population engaged in agriculture

g. High rate of population growth

h. Low percentage of literacy

These indicators show that the developing countries are facing both human and resource use problems. The low standard of living prevailing in these countries is the outcome of high population density, resource scarcity, ignorance and improper resource use.

Forest Resources

The developing countries portray an enigmatic forest resource situation. The forest resource is either too deficient, as in the Middle Eastern countries, or is inadequately or improperly used, as in South America (13). Table 1 gives the forest resources of the developing

countries as compared with their total land areas and populations. The forest areas have been sub-divided into accessible, inaccessible and other forests, the last category being mostly unproductive wastelands:

Table 1. Forest Resources of the Under-developed World.

Unit: hectare. Extent: x 1000 ha.

Country	Population (Millions)	Total Land Area	Total Forest		Productive Forest		
			Area	%	Accessible	Inaccessible	Other Forests
Afghanistan	15.9	64,750	1,000	1.5	700	300	-
Algeria	11.4	219,502	3,000	1	1,635	-	1,365
Angola	5.2	124,670	4,000	3	-	-	-
Argentine	22.7	278,344	48,570	17	17,138	5,748	25,684
Bahamas	0.1	1,037	112	10	112	-	-
Basutoland	0.6	3,035	10	0.3	10	-	-
Bechuanaland	0.6	71,600	170	0.2	147	23	-
Bhutan	0.8	4,660	2,000	43	-	2,000	-
Borneo	0.9	19,541	16,835	82	4,144	777	11,914
Brazil	83.9	851,170	395,928	46	152,618	224,552	18,758
Burma	25.2	67,795	39,094	58	25,372	-	13,722
Camerouns	5.3	42,000	28,800	69	2,300	16,500	10,000
Ceylon	11.5	6,484	3,531	55	1,009	42	2,480
Chile	8.8	74,177	16,223	22	4,982	1,700	9,541
China (Com.)	735.0	944,420	82,805	9	16,892	39,415	26,498
Colombia	18.4	105,941	72,000	68	6,500	42,000	23,500
Congo	16.9	233,812	120,638	53	69,156	50,500	982
Cuba	7.8	11,655	3,463	30	2,585	-	878
Cyprus	0.6	925	169	18	137	8	24
Dominican Rep.	3.8	4,954	3,440	69	3,440	-	-
Ecuador	5.2	27,500	15,000	55	5,000	10,000	-
Egypt	30.4	100,025	0	0	-	-	-
El Salvador	3.0	3,413	1,992	58	1,992	-	-
Ethiopia	23.0	102,471	3,000	3	150	850	2,000
Fiji Island	0.6	1,843	957	52	910	47	-
Gambia	0.3	1,040	405	39	-	405	-
Gold Coast	4.1	23,783	16,058	67	4,131	4,934	6,993
Greece	8.6	12,800	2,000	16	500	100	1,400
Guadeloupe	0.5	172	84	47	10	21	53
Guatemala	4.6	10,890	7,200	66	690	-	2,200
Guiana	0.7	29,849	25,130	87	4,026	16,960	4,144
Haiti	4.8	2,775	690	25	690	-	-
Honduras	2.4	17,620	11,611	65	11,066	13	532

(Continued)

Table 1. (Continued).

Country	Population (Millions)	Total Land Area	Total Forest		Productive Forest		Other Forests
			Area	%	Accessible	Inaccessible	
India	494.1	222,388	41,958	19	31,339	1,295	9,324
Indo-china	54.0	74,000	31,000	42	-	-	-
Indonesia	106.8	190,435	120,000	63	11,000	59,000	50,000
Iran	24.0	163,300	27,000	17	13,000	6,000	8,000
Iraq	7.3	30,188	1,500	5	-	-	1,500
Israel	2.7	2,085	89	4	8	-	81
Jamaica	1.8	1,089	197	18	58	-	139
Jordan	2.6	9,035	35	0.4	25	3	7
Kenya	9.6	56,910	1,430	2	293	183	954
Korea (N & S)	41.7	220,840	13,107	6	-	13,107	-
Lebanon	2.4	880	80	9	74	-	6
Liberia	1.5	11,133	3,885	35	-	3,885	-
Libya	1.7	175,954	178	0.1	8	-	170
Madagaskar	6.6	59,470	7,000	12	1,500	1,000	4,500
Malaya	9.7	13,225	10,124	77	2,034	5,306	2,784
Mauritius	0.8	186	61	33	0.6	2.6	58
Mexico	42.2	196,937	28,000	15	20,000	-	8,000
Mozambique	7.0	78,369	19,400	25	6,400	10,000	3,000
Mongolia	1.1	153,100	3,000	2	-	3,000	-
Morocco	13.7	46,712	4,700	10	2,950	-	1,750
Nepal	10.2	14,000	3,500	25	500	3,000	-
New Guinea	1.0	47,000	35,000	74	-	22,000	13,000
Nicaragua	1.7	14,800	6,450	44	6,450	-	-
Nigeria	58.7	96,613	32,673	34	1,424	7,381	23,868
Nysaland	4.8	9,539	1,761	19	648	673	440
Pakistan	121.1	93,500	4,817	5	3,056	1,347	414
Panama	1.3	7,401	6,300	62	4,960	-	1,340
Paraguay	2.1	40,673	12,360	30	5,000	7,360	-
Peru	12.0	112,460	70,000	62	15,000	35,000	20,000
Philippines	33.4	29,741	17,496	59	13,198	-	4,298
Puerto Rico	2.7	891	88	10	76	4	8
(N) Rhodesia	1.7	75,188	30,043	40	5,568	14,115	10,360
Saudi Arabia	6.9	3,885	200	5	200	-	-
Sierra Leone	2.3	7,252	259	3	10	192	57
Somalia	2.6	68,000	27,000	40	64	-	26,936
Somaliland	1.6	17,612	300	2	-	-	300
Spain	31.9	50,306	9,500	19	5,000	-	4,500
S.W.Africa	0.6	82,290	400	0	400	-	-
S. Rhodesia	4.4	38,942	21,922	56	5,776	3,756	12,390
Sudan	13.9	250,582	93,240	37	1,295	2,202	89,743
Swaziland	0.2	1,736	425	24	21	-	404
Syria	5.5	18,560	375	2	20	80	275
Tanganyka	10.5	88,761	50,453	57	50,246	-	207

(Continued)

Table 1. (Continued).

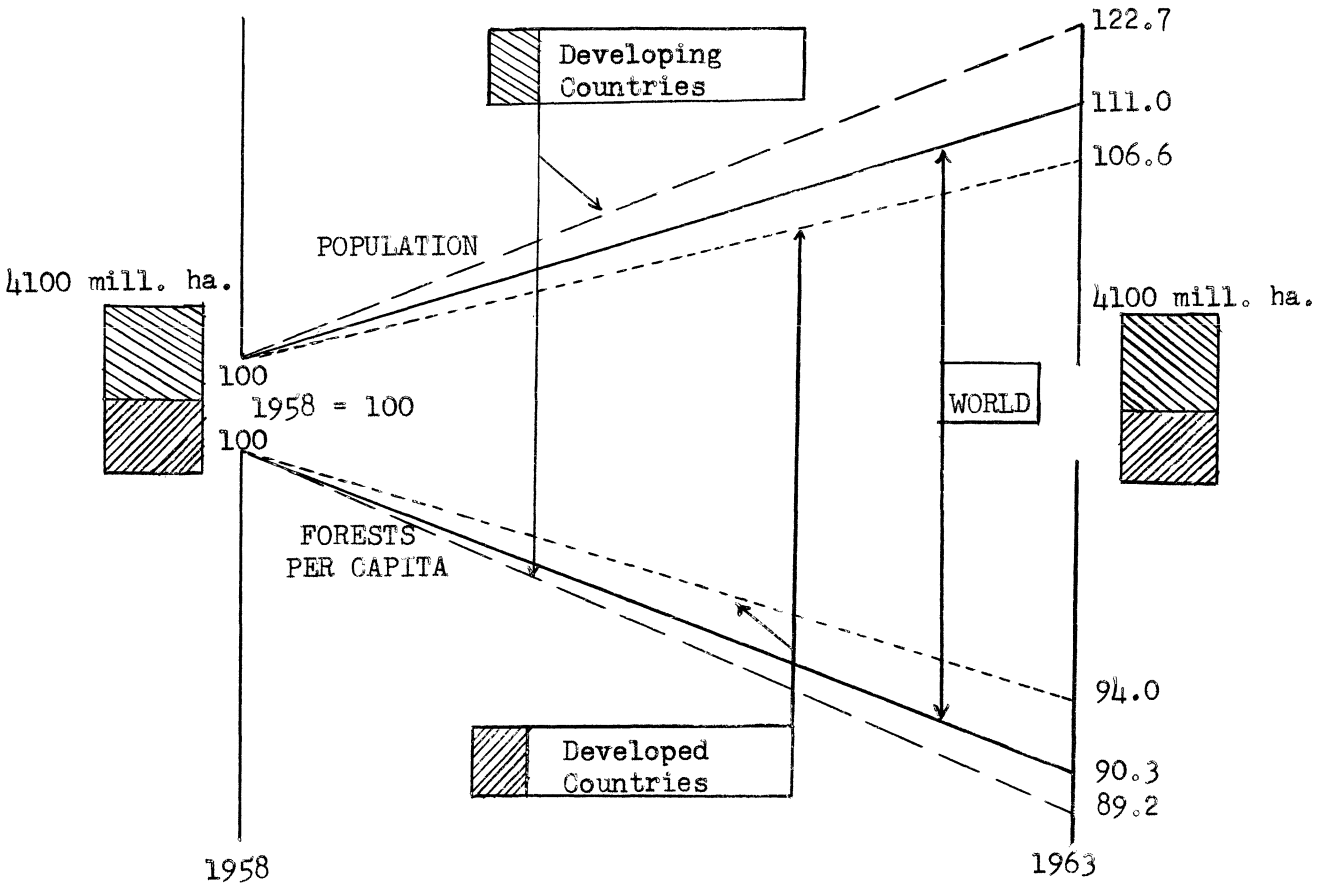
Country	Population (Millions)	Total Land Area	Total Forest		Productive Forest		Other Forests
			Area	%	Accessible	Inaccessible	
Thailand	31.5	51,345	32,431	63	10,779	21,652	1
Trinidad and Tobago	1.0	513	258	59	77	181	-
Tunisia	4.8	12,518	1,377	11	1,377	-	-
Turkey	32.0	76,711	12,000	12	3,000	6,170	2,830
Uganda	7.7	20,796	1,709	8	518	1,191	-
Uruguay	2.7	18,617	452	2	378	74	-
Venezuela	9.0	91,205	36,500	40	7,000	28,500	1,000
Yemen	5.0	19,425	180	1	180	-	-
Yugoslavia	19.7	25,688	7,780	40	7,780	-	-

Sources of data: 1. World Population Data - 1966 (Population Reference Washington, D.C.). 2. F.A.O., World Forest Inventory, 1963. 3. Yearbook of Forest Products Statistics, 1965 (F.A.O.). 4. Commonwealth Forestry Conference, 1964. 5. Zon and Sparhawk, 1923. 6. U.N. Statistical Yearbook, 1965.

The total forest area of the world is 4,100 million hectares (84), which has to cater to a population of 3,346 million people (86). The developing countries had about 2,510 million people and 2,200 million hectares of forest area in 1966. Contrasted to this, the developed countries had, in the same year, a population of about 836 million and 1,900 million hectares of forest area. Diagram No. 1 shows the per capita distribution of forests in the developed and developing countries (84, p. 4).

It is evident that the per capita distribution of forest area decreased between 1958 and 1963, more sharply in under-developed areas than in the developed countries. World population has been increasing at 1.7 percent per annum since 1958, which could further decrease the per capita distribution of forests between 1963 and 1966. It is estimated

Diagram No. 1. Per capita Distribution of Forests.



that this decrease has been 6 per cent in the case of developed and 12 per cent in the case of developing countries. Table 2 shows the decrease in per capita distribution of forest land and forests.* For the sake of comparison, data for both developed and under-developed regions have been given in this table.

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* Forest land is defined (84, App. 1) as "land bearing vegetative associations dominated by trees of any size, exploited or not, capable of producing wood or other forest products, or exerting an influence on the climate or the water regime, or providing shelter for livestock and wildlife. It includes clearcut or burned over lands which will be reforested in the foreseeable future; public or private forests, forest nurseries and roads and small open areas constituting an integral part

Table 2. Forest Area Per Capita and Crop Density.

Region	Forest Area per cap. ha.		Forest per cap. ha.		Growing stock per ha. m^3	
	1963	1966	1963	1966	1958	1963
Central America	1.0	0.91	0.97	0.89	85	80
South America	5.7	5.22	5.3	4.85	125	185
Africa	2.4	2.24	2.4	2.24	25	45
Asia	0.3	0.29	0.28	0.27	90	90
Others	5.7	5.61	5.4	5.32	65	60
World	1.3	1.24	1.2	1.14	87	96
Developed Nations	2.1	2.02	1.9	1.82	95	100
Under-developed	0.95	0.89	0.90	0.84	78	92

Although some increase in the growing stock has been reported all over the world, F.A.O. (84) considers it a result of improvement in inventory techniques and the inclusion of areas which were hitherto unreported. There has been a world-wide decrease in per capita distribution of forests and forest lands. This is an alarming situation in view of

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of the forest; forest plantations, bamboo stands; lands affected by shifting cultivation, but not those which are under permanent agricultural use; savannah with density more than 0.05."

Forest is defined as the crop, predominantly trees or bamboo stands, covering a forest land which may or may not be productive (84, App. I). Productive forests are those forests which are capable of producing crops of usable wood. The forests where ecologically adverse conditions limit physical productivity to such an extent that all economic exploitation is impossible, are classed as unproductive.

the fact that resource deterioration still continues in the developing countries (1, 25, 34, 61, 68, 74) because of many reasons which will be discussed in the following pages.

Management Status

There is an increasing trend in the developing countries to bring their forest areas under some form of management plan (55, 84). The following table shows the management status of forests. For the sake of brevity, countries have been combined into continental regions (55, 84).

Table 3. Management Status.

Region	Forest Area (mill. ha.)	Ownership (million hectare)			Management (mill. ha.)		Growing stock (1000 mill. m^3)	Density %		
		Pub.	Priv.	Misc.	Man-aged	Unman-aged		Good	Med-ium	Poor
Central America	76	21	26	29	7	69	0.8	29	44	27
South America	890	341	269	280	115	775	78.0	72	19	9
Africa	710	250	68	392	90	620	3.8	37	20	43
Asia	550	283	25	242	118	432	17.0	51	29	20
Others	96	21	62	13	52	44	3.8	47	39	14

The above table shows that large forest areas still are not under any form of management. It does not mean, however, that these forests are not being used. Quite the contrary. These forests are used for extraction of forest produce, grazing or shifting cultivation, either

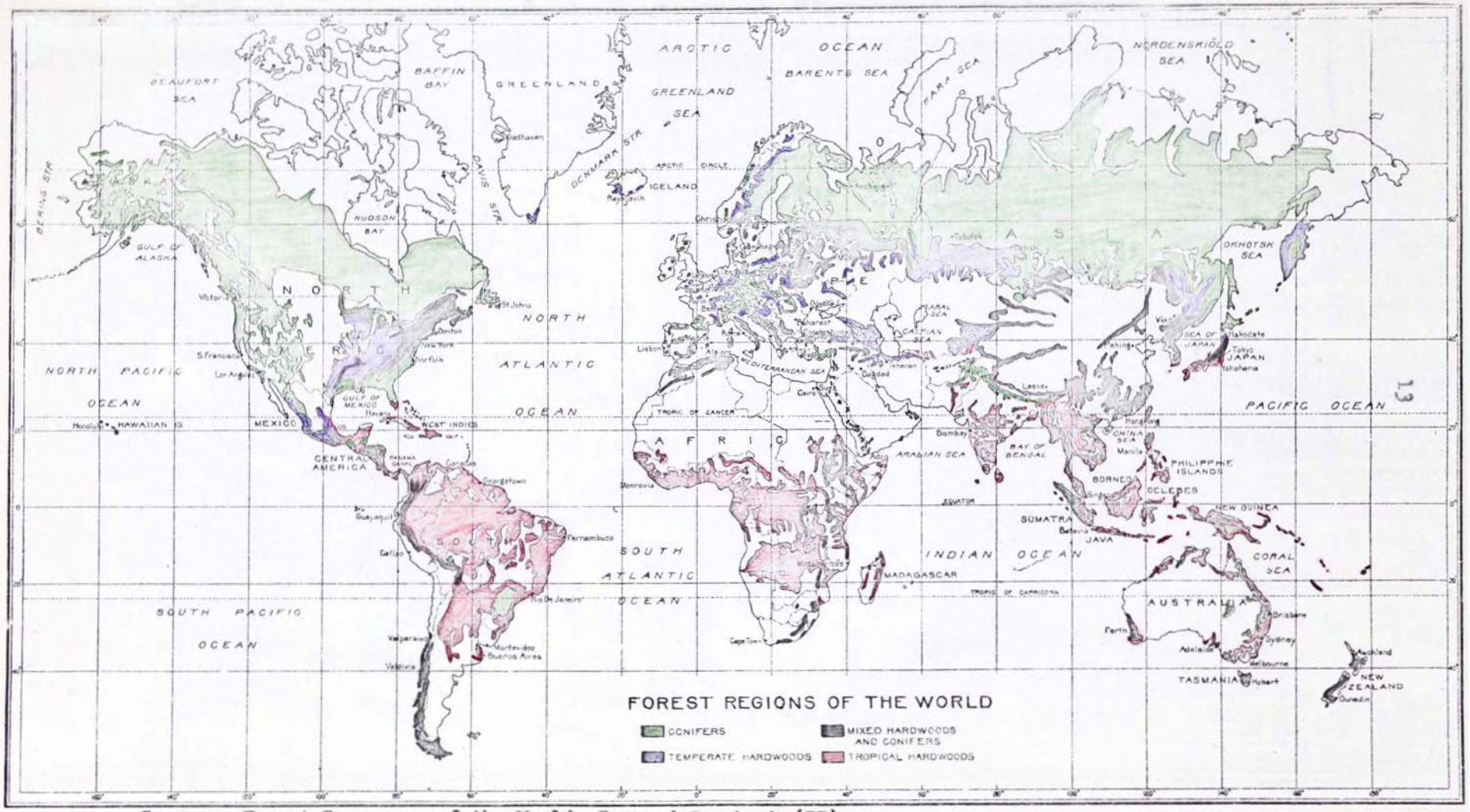
by the owners or the right holders* (55). Since more than 70 per cent of the area is not under regular management, the use of the forest resources is uncontrolled. Such traditionally uncontrolled forest exploitation has mainly been responsible for denudation of extensive areas in Asian and African countries (34). The nature and extent of uses in these regions is determined by the current needs rather than by interest in the resource or its future. The management or use pattern is determined by the socio-economic conditions and cultural outlook of the community or nation concerned. Since most of the developing countries have predominantly pastoral-agricultural economies, pressure on the forest resources is imperative. As will be discussed later on, the ecological requirements of the forest community are given little consideration in the present use patterns in such countries. The community forests, for instance, are over exploited without any significant administrative control (32, 55).

Regional Forest Situation

As a result of environmental limitations and/or use patterns, the distribution of forest areas has become inequitable in the underdeveloped regions of the world. This can be readily distinguished in the map given on page 13. For the identification of the management problems, it is necessary that their present use and management situations should be examined. The following paragraphs deal with the

* Right holder is a person who is permitted by tradition or law to use the forest for his domestic purposes. This forest use may be for grazing of livestock, extraction of various kinds of produce, shifting cultivation, etc. The rights are exercised either free or at nominal costs. Most of the public and community forests of developing countries are burdened with use rights.

MAP NO. 2.



Source: Forest Resources of the World, Zon and Sparhawk (77).

regional distribution of forests and their uses. The implications of these uses will be discussed in Section II.

A. Central and South American Forest Region.

Of the 966 million hectares of the forest lands, about 50 per cent are in a productive state (84). The rest of the area contains deteriorated forests and a mixture of shrubs and grasses. The vegetation generally shows transitional forms between forest and steppe, such as Llanos and Campos. The main forest concentrations are found around the Orinoco, Brazilian highlands and the Guiana highlands. Although climatic conditions and fires play some role in the development of this vegetation pattern, the main influence is continuous heavy grazing and migratory cultivation (58). In 1950, there was an estimated population of 155 million domestic animals in South America, and 75 per cent of Central and South America was under heavy grazing (13). Peru alone, for instance, has about 30 million animals which graze on small portions of its 70 million hectares of forest and grassland. Continuous heavy grazing on the dry slopes of the Andes has resulted in the severe deterioration of vegetation and soil (71).

B. African Forest Region.

The Sahara, Libyan and Kalahari deserts have confined the forest area to 710 million hectares in the central parts of the continent. The main vegetation types are savannah, dry mixed forest, semi-moist mixed deciduous forest and moist evergreen forest. The savannah, dry and semi-moist forests are used for livestock grazing by nomadic tribes such as the Massais, Dincas, Hereros, Bantus, Hottentots and Berbers. Shifting

cultivation is also widely practiced throughout Africa (58, 64). According to Stebbing (64), vast areas of mixed deciduous forest in West Africa and south of the Sahara have been reduced to savannah by overgrazing and shifting cultivation. Patterson (58) and Stebbing (64) have emphasized the central role played by man in the deterioration of African vegetation and soil. The traditional practices and cultural handicaps, however, still hinder the progress (79).

C. The Near and Middle Eastern Forest Region.

Most of these forests are situated around the southern parts of the Black Sea and the Caspian Sea. They occupy less than 1 per cent of the total land area, being only 40 million hectares in extent. About 30 million hectares are productive (84). According to Helfman (34), the Near and Middle Eastern region had good forests about 5,000 years ago. Patterson (58) attributes this depletion to overgrazing, which produced a pronounced reduction in natural vegetation. The almost irreversible condition created by man and his livestock in this region over the past 5,000 years (34) is well portrayed by Jervis, quoted by Wehrwein (72) as saying, "Arab is not the son but the father of the desert." The severe climatic conditions may also have been one of the factors responsible for the creation of deserts (2, 33, 34). The main use of the forests in this region still continues to be grazing and firewood extraction. (33).

D. The Indian Peninsular Forest Region.

This region contains 42 million hectares of forests, of which 39 million hectares are productive (55, 84). Most of the forests are

situated on the slopes of the Himalayas and its sub-ranges, the Deccan Plateau and along river courses. The main forest types are temperate forest, moist mixed forest, semi-moist deciduous forest and dry thorn forest. These forests have traditionally been used for grazing, migratory cultivation and exercise of other use rights by the people. About 20 million hectares are under regular management (84) while the remaining are either unmanaged community forests or government wastelands.

E. Indonesian-Indochinese Forest Region.

This region has 305 million hectares of forests, of which 212 million hectares are productive (58, 77, 84). The main forest types are moist evergreen and moist mixed deciduous forests. Semi-moist forests are limited in extent (58). This region is probably the best preserved in the under-developed world, as it shows little signs of overuse as contrasted to the Middle East. This may be partly attributed to inaccessibility of the forest areas. Shifting cultivation is, however, widely practiced (74). About 50 million hectares in this region are under regular management, which is about 17 per cent of the total forest area of this region.

F. The Mexican Forests.

Of the 35 million hectares of forest area in Mexico, 27 million hectares are productive (58, 77, 84). Most of this area is economically inaccessible, being marginal forests bordering on deserts or serving some vital function such as watershed protection. About 10 per cent of this area is covered by working plans, the rest being under contractual, legal or irregular management (84). The productivity of the forests is

rather low, which is attributed to heavy use by the people of Pre-Columbian cultures (58) and excessive mining and grazing. Some Mexican forests were over-exploited by domestic and foreign companies between 1880 and 1920. Charcoal burning has been an important use of the forests. According to Patterson (58), conditions exist, especially in Sierra Madre, central and eastern Mexico and Yucatan for increasing forest productivity by improved management.

G. Chinese-Tibet Forest Region.

Of the 96.3 million hectares of forest area, 57 million hectares are reported to be in productive condition. Richardson (61) has also confirmed these figures, but states that by 1966, an additional 100 million hectares have been afforested, raising the forest area to 196 million hectares. However, the yield of wood is still low, the forests being either too young or over-exploited in the past (58, 61). There are 5,000 woody species, both conifers and broadleaved, growing in Chinese forests. All the forests have been brought under management under State Council Promulgation of 1963 (61), which recognizes multiple values of the forest resource. Grazing is being brought under control, and economic and productive aspects of forestry are being stressed (61).

Current Resource Utilization

The primary use of the forests in the under-developed world remains the removal of timber and firewood. This constitutes an important proportion of total forest revenue. However, there are exceptions, such as China (61) and Korea (55), where protective values are given more weight than the production of wood. The following table gives the removal of firewood and timber in various under-developed regions (55, 84).

Table 4. Growing Stock and Wood Removals.

Region	Forest Area (mill. ha.)	Growing Stock (million m^3)	Removals (1960-62 Annual Avg.) Industrial wood (million m^3)	Firewood (mill. m^3)	Total (mill. m^3)
Central America	76	800	7.1	36.0	43.1
South America	890	78,000	26.0	155.0	181.0
Africa	710	3,800	22.0	174.0	196.0
Asia	550	17,000	122.0	258.0	380.0
Others	96	70,000	16.0	9.2	25.2
World	4,126	238,000	1,021.0	879.0	1,900.0
Developed Nations	1,900	195,000	844.0	256.0	1,100.0

Table 4 shows that the industrial use of wood in the under-developed countries is 23 per cent of the total removals; 77 per cent of the total cut for industrial purposes. This indicates a lack of alternative fuel resources and a backward state of economy. However, this use pattern is showing a progressive trend, and industrial use of wood is increasing in the developing countries (78). The change in use pattern will perhaps call for a change in the management pattern. The forest manager might in the future have to promote a more advanced use of wood, which would mean production of better crops, cultivation of improved species and application of better silvicultural and extraction techniques.

Grazing. Grazing of domestic livestock is another important use of forest lands in many developing countries (1, 13, 32, 34, 55, 64).

According to Chapline (13), 75 per cent of forest areas in South American countries is used for grazing; 80 per cent of Mexico is grazed (10), of which 33 per cent is grassland, the rest being forest, desert or agricultural land. About 60 per cent of Turkey's land area, including 12 per cent forested land, is under grazing use (21). About 48 per cent of Pakistan's land area, including 4 per cent forested land, is under grazing use by about 60 million head of livestock (40). Continuous and unrestrained grazing has resulted in the deterioration of vegetation and soil (32, 58). Illicit grazing incidence is high in a majority of the developing countries (55). Invariably, the legally permitted grazing is uncommensurate with the carrying capacity of the forests (10, 13, 33, 71).

The graziers are more or less interested in the number of animals rather than their quality, or meat, milk or wool yields (13, 40). Such animals are incapable of converting forage into body weight, etc., efficiently. The livestock owners ostensibly believe that a larger herd, no matter of what quality, will give them better social and economic status.

However, the developing countries are becoming more and more aware of the need of bringing grazing in forest areas under control (55, 61, 84) and improving the livestock. The Promulgation of the State Council of China, 1963, lays down the process of solving grazing problems in the Chinese forests (61). The Goat Eradication Ordinance of Pakistan (1959) and similar steps taken in Turkey, Iran, Yugoslavia and Nigeria in recent years indicates the anxiety of these nations about the consequences of uncontrolled grazing. The F.A.O. (55) National Progress Reports of 1964 show that legislative measures are being taken in most countries to regulate grazing in the forest areas.

Shifting cultivation. Migratory cultivation is still widely practiced in almost all under-developed countries. This ancient form of land use has been responsible for more reduction in forest areas and forest damage than all other factors combined. It was widely practiced in England in the 5th century A.D., and was responsible for reduction in forest area from 75 per cent to about 35 per cent in about 500 years. Shifting cultivation resulted in the reduction of forest area in Germany from 80 per cent to 25 per cent between 750 and 911 A.D. (35). Shifting cultivation had done so much damage in West Africa that Stebbing (64, p. 48) wrote in 1937, ". . . it would be difficult to find an area of high forests of sufficient size to form a reserve forest. . . ." Migratory cultivation and burning over a long period has resulted in the disappearance of mixed deciduous forests and creation of savannah in West Africa. Wyatt-Smith (74) mentions that about 5 per cent of Malaya is still under migratory cultivation. This has resulted in the destruction of valuable high forests, whose place has been occupied by bamboo. In many areas, grasslands have replaced high forests, especially in Tapah Hills of Malaysia (74). Wyatt-Smith also mentions that shifting cultivation is more damaging in Far Eastern Asia than in Malaya (74). It is equally serious in the African continent and many parts of South and Central America. Like grazing, however, there is an increasing effort to bring it under some form of managerial control. The adoption of the taungya system*

* Taungya system is the controlled form of shifting cultivation. The terminology of this system varies from region to region, but its practice is generally the same. The cutover areas are allotted to cultivators, who burn the slash, remove the stumps and till the land for a short period, generally 2 to 3 years. Before the expiration of this period, the cultivators plant sapling trees under the supervision of forest officials in lieu of concession given to them for raising of agricultural crops in the cutover areas.

as a silvicultural tool in some Asian and African countries is perhaps an important step towards settlement of the agricultural nomads. The Aboriginal Peoples Ordinance, 1953, and Forest Rules, 1935, were important legislative efforts in Malaya (74) to bring shifting cultivation to a stop by permanent settlement and education of these agricultural nomads.

Other Uses. Recreational use of forests had little significance in the under-developed countries in the past. It has been, however, showing an increasing trend during the past decade or so, especially hunting and fishing. The F.A.O. Asia-Pacific Commission (55, p. 3) reported in 1964:

> . . . countries such as India, Pakistan, Thailand . . . have further progress to report in the field of national parks, wildlife conservation and recreation, particularly in the creation of more sanctuaries and national parks. . . .

Recreational use of Changa Manga National Park, Kalam National Park and other forests adjacent to populated areas in Pakistan in the past decade indicates increasing attention to the field of outdoor recreation in the developing countries.

In many developing countries, the protective role of forests is being significantly appreciated. Richardson (61) mentions that the protective value of forests has been given a primary importance in the State Council Promulgation (1963) of Communist China. The basic purpose of the enactment of the Chos Act, 1935, in Indo-Pakistan was soil and water conservation in the mountainous areas. In Korea, 80 per cent of the budgetary allocation to the Forest Bureau in 1963 was spent on the improvement of protective value of the forests (55, pp. 2-3). The Korean government has enacted the Erosion Control Law and Accelerated Greenification

Law in order to facilitate effective water and soil conservation (55). In the Philippines, a division of watershed management has recently been created in the Bureau of Forestry to look after the protective values of the forests (55). The significance of these measures is two-fold: (1) they indicate that the developing countries are well aware of the serious consequences of erosion, floods and siltation of water courses which follow denudation of forested watersheds; and (2) these countries have come to realize that forests have multiple values, which deserve equal attention to development as well as utilization. There is, however, a need for integration of various management aspects to create an effective, coherent element in resource rehabilitation. This will also lead to increase in the wood yield, which is lamentably low in the developing countries (29).

SECTION II

THE PROBLEMS

The developing countries face the same problems today which Europe and America faced in the 18th century, namely, the change of economic and cultural values in the wake of modern technology. Only the dimensions of these problems are larger. The developing countries are plagued with over-population. Their resources have been misused for many centuries. Above all, they suffer from a socio-economic impatience to make up the lost time and provide a better level of living to their masses. Their progress is hindered by many limitations imposed by cultural, economic, technological, political, organizational and environmental factors. Some of these factors actually negate whatever progress might have been achieved in other fields. Any change in the pattern of resource use or management can prove effective if it is modified to function within these limitations. Alternatively, the change must come when the atmosphere is conducive to a change.

Population

The major problem of under-developed countries is their large populations and alarming rates of growth. The attempts made in the recent past by many developing countries to increase their standard of living have been annulled by this factor. Pakistan, for instance, has had an increase of 6 per cent in her gross national product every year for the past 5 years, but her population is growing at the rate of 3.2

per cent per annum. Consequently, the actual increase is not adequate enough to produce visible changes in the standard of living of the common man. Table 5 shows the present situation prevailing in the developing regions (86).

Table 5. World Population in 1966, Growth Rate and Projections.

Region	Present Population (millions)	Annual rate of increase Per cent	Population in 1980	No. of years needed to double the Population
Central America	78.8	2.7	153.3	26
South America	169.2	2.7	247.0	26
Africa	313.9	2.3	449.6	31
Asia	1,889.6	1.8	2,682.8	39
Others	76.2	1.6	94.8	42
World	3,346.0	1.7	4,330.0	41
Developed Nations	818.3	1.1	1,042.0	63

The developing countries have 75 per cent of the world population while they occupy 59.1 per cent of the world's land surface. Contrasted to this, the developed countries have 25 per cent of the world population and 40.9 per cent of land surface. The forest areas in these two categories are 2,226 and 1,900 million hectares or 54 and 46 per cent, respectively. This situation, alarming as it is, calls for a shift in resource management so as not only to provide better goods and services, but, also, to increase productive potential of the forest land.

The gross national product and per capita income varies widely

in the developing world. Ethiopia has a per capita income of $42 per annum, India $75, Malaya $85, and Venezuela $300 (54, pp. 4-7). This is miserably low compared to $1500 in the United Kingdom and $2400 in the U.S.A. (54). More than 50 per cent of the world's population has an annual per capita income of less than $75. Together, the under-developed countries earn 13 per cent of the total world income (54), although they have 75 per cent of the world population and 59 per cent of the land area.

The solution of the adjustment of population to the available resources depends upon the ability of given nations to use these resources efficiently at a given time. While there is an immediate need for reducing the rate of population growth in most of the developing countries, land use policies also need adjustments in consideration of the long-term productive capabilities of land.

Scarcity of Resources

The existing forest resources of the under-developed countries, comprising 2,226 million hectares and about 100,000 million cubic meters of growing stock, seems apparently adequate for a population of 2,528 million. Actually, a state of resource scarcity is developing in these countries. Their population will double in an estimated period of 26 years, which will place an additional burden on the forest resources. The Food and Agricultural Organization (55, 78) forecasts that the consumption of paper, pulp and other wood products is likely to increase in the developing countries because of rising standards of living and increasing population. Grazing of domestic livestock and migratory cultivation might not decrease considerably in the foreseeable future.

On the other hand, such uses as recreation, etc., are likely to increase. The area under forest cover is decreasing in many countries. For instance, during the past 10 years the forest area in Turkey has decreased by 40 per cent (21). Malaya's forests have decreased by 5 per cent in the last 35 years (74). Pressure on forest resources, combined with frequent fires and other damaging forces, can generate scarcity.

Fisher (25) has said,

> . . . the question of resource adequacy has always been significant; it will not become less so in the future. Throughout history people have been concerned with the relationship between themselves and the land and other resources. . . .

In forestry, as in other sectors, resource scarcity may be indicated by high prices of products, extent of imports into a particular region, inadequate forest area for water and soil conservation, and consequently poor water supply and agricultural production. "Scarcity increases as the population increases, as it is the reciprocal of the population." (25). The resources of the developing countries will continue to experience pressurized use unless the growth of population decreases substantially. The conditions of scarcity can also be reversed by technology and substitutes, both of which are unavailable on a large scale to the developing countries. Therefore, the developing countries might encounter a serious resource scarcity as a result of universal pressure on forests. According to Fisher (26),

> . . . the increase in the rate of wood removals from the forests between 1946 and 1960 was about 40 percent. During the next 40 years, the increase may be 150 percent. Even the 40 percent rate of increase in aggregate cut in the past 14 years has been moderated by the inclusion of fuelwood which increased very little. Sawlog cutting increased 66 percent during 1946-60; projected for 40 years this may increase by more than 300 percent (or 70 percent per capita). . . .

The F.A.O. (78) estimates that the world wood consumption may increase four times, and that in under-developed countries more than ten times by 1980. Fisher (25) thinks that resource research, conservation practices, development and better management can contribute towards avoidance of incipient tendency towards scarcity. The under-developed countries are more in need of these actions than the developed countries. This aspect will be discussed in Section IV.

Historical Causes

The backward areas of the world have been misused for many thousand years. The first clearance of land was started in the Nile Valley about 6,000 years B.C., and in Mohen-Jo-daro and Harappa (Pakistan) about 5,000 years ago (34, 40). Almost a contemporary of the Indus Valley civilization were the Euphrates and Tigris civilizations, where irrigated farming was practiced by a network of irrigation canals. Helfman (34) attributes the decline of the Indus Valley and Euphrates-Tigris Valley civilizations to the siltation of their canal systems because of misuse of land in the catchment areas.

Greece may once have had magnificent forested hills. In the 4th century B.C., denudation had reached such an alarming stage that Plato had to say (34, pp. 43-45):

> "What are now bare mountains were lofty soil-clad hills; her so called shingle plains of the present day were full of rich soil; and her mountains were heavily afforested--a fact of which there are still visible traces. There are mountains in Attica which can now keep nothing but trees, but which were clothed, not so very long ago, with fine trees. . . ."

The Chinese civilizations grew on loessal soil. The devastation of trees and vegetation was so extensive during the past 2,000 years that 70 per

cent of Chinese land has been badly eroded (61). Emperor Baber shot a rhinoceros in the Khyber Hills of Pakistan which are almost bare of soil and vegetation today.[1] The conquest of the Incas by Spaniards led to the decay of Inca civilization and the eventual misuse of land in the Andes mountains. The decline of the Mayas is also attributed by some authorities to misuse of land (34).

The developing countries have inherited the consequences of misuse of land. Unfortunately, many of them have also inherited the outlook and the values which are detrimental to their resources. If they want to break the shackles of ignorance, poverty, hunger and disease, they will have to abandon traditional attitudes toward their resources.

Climatic Limitations

"The capacity of land to satisfy human wants varies considerably in various parts of the world. . . . The land figure of 4 hectares per capita also contains deserts, mountains, snow caps, etc. . . ." (1). The deserts impose probably the most restrictive limitation on land-use. From both forestry and agricultural points of view, the world's 450 million hectares of deserts (1) have only marginal value. This vast amount of land supports grass or shrub growth, and is more or less under nomadic pasturage. Most of the deserts need reseeding and reforestation. This is necessary to rehabilitate both productive and protective potential of arid lands. This could possibly be achieved by better management practices. Fortunately, the desert areas are sparsely populated.

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[1] "Tozak-e-Babari," Ferozsons, Lahore, Pakistan. Also mentioned in The People of the Khyber, W. J. Spain (New York: Praeger, 1963).

Their management, therefore, does not call for serious disturbance of population.

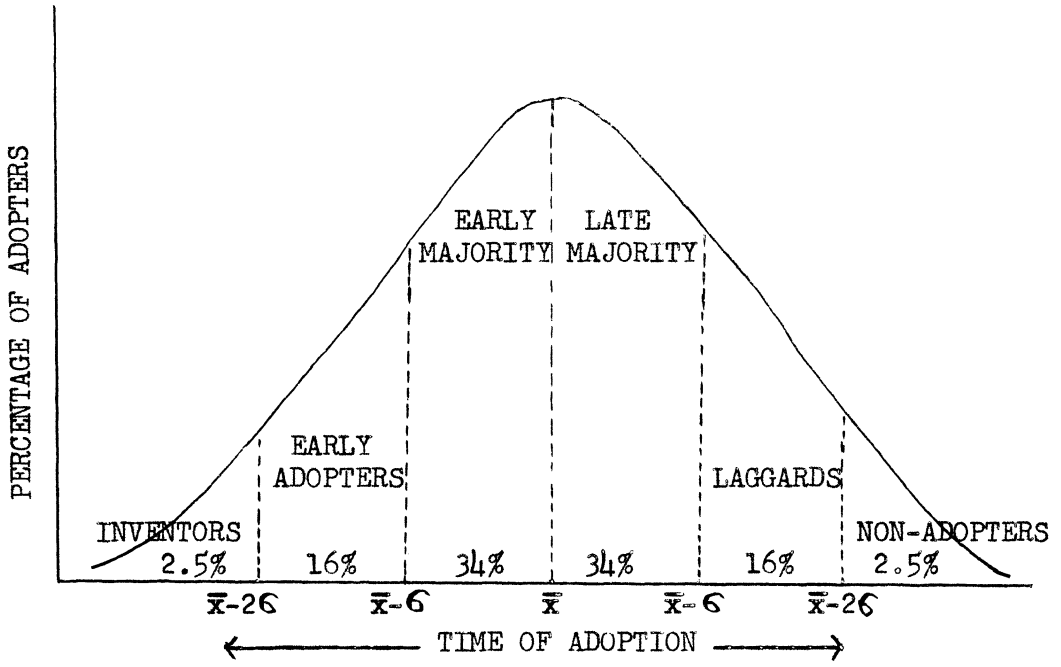
Deserts occur on almost every continent. Most of the arid zones are located in the developing countries. While this is a serious obstacle for land use development, it is also a challenge to modern technology. The future welfare of the developing nations might lie in the conquest of desert lands.

Technological Limitations

Technology has been described as an inexhaustible resource. It is certainly true, as man is capable of manipulating the environments for his economic welfare. The developing countries are deficient in technical resources--both trained manpower and capital equipment. The diffusion of technical knowledge into many developing countries is rather slow, being hindered by geographic, cultural, political and economic reasons. Most of the under-developed countries have inadequate communication facilities. In many regions, topographic barriers and high cost of development of communications are serious problems. There is a high percentage of illiteracy in some countries, where the people are not prepared to abandon their old customs and values (11). Where political and cultural environments are receptive to development, adequate capital may not be forthcoming. Together, these factors inhibit the diffusion of technical knowledge. Consequently, a time lag of a century or so may exist between the technological status of a developed and a backward society. This time lag continues widening as the advanced cultures are gaining more and more developmental momentum and the under-developed countries are groping to hold their steps

on the first tiers of development. Jones, quoting Rogers, has created a conceptual model of adaptability of technology, which with modification is given in Diagram No. 2 (11, p. 477).

Diagram No. 2. Conceptual Model of Adaptability Trends.



This curve illustrates a model of the process of adoption of technology. It follows the trend of a normal curve. Considering the human race as a whole, the distribution of adopters over time can be estimated around the mean $\bar{x}$. Rogers has given the following formula for the determination of time of adoption of an innovation by an individual:

$$U_i = \frac{x_i - \bar{x}}{\sigma}$$

Where:

U_i = an individual's position in the curve of adoption

x_i = actual date of adoption by an individual

$\bar{x}$ = mean date of adoption of the population

σ = standard deviation of adoption dates for the population.

Among the constellation of nations, 2.5 per cent lying at $(\bar{x} - 2\sigma)$ from the mean can be considered as inventors; 16 per cent lying between $(\bar{x} - 2\sigma)$ and $(\bar{x} - \sigma)$ are the early adopters and 34 per cent lying on the immediate left of $\bar{x}$ is the majority which follows the early adopters. The developing countries can be put to the right side of $\bar{x}$, with 34 per cent who have taken up the process of development, 16 per cent who are still dubious, hesitant and shy, and 2.5 per cent altogether primitive. This time lag is aggravated by the cultural outlook of the nation concerned and her will to improve her lot (54, p. 32).

Moyes and Hayter (54) say that science may help increase the resources and potential of the developing countries. These countries can benefit greatly from the existing technology and management techniques (54). Fortunately, the third quarter of the 20th century is witnessing a revolution in the economic and technical fields all over the world. The inflow of technical knowledge from advanced to under-developed countries has increased steadily during the past two decades (25, 54) with improvements in international communication and transport facilities, and increasing exchange of goods and services. With an illiteracy rate of 70 per cent or more, many under-developed countries are still many years from possession of a corps of adequately trained technicians and professional managers. Forestry is no exception.

Economic Limitations

Why are some countries under-developed? There is no single entirely convincing reason. Some authorities (54) attribute under-development to climate, historical cycles, innate physical and intellectual ability, malnutrition, colonial exploitation or "missing factors". According to Moyes and Hayter (54, p. 33):

> The factors thought essential for development are natural resources, capital, entrepreneurial and managerial ability, education, a will to develop, a climate of beliefs favorable to development, and a minimum standard of law and public administration.

Supply of capital is essential for forest resource development and better utilization (29, 54, 55, 79). Development of communications, extraction routes, industries, inventories, effective administration and education all demand capital. Since the claims on allocations come from many other developmental agencies, the allocating authority has to adjust the distribution of capital within the limits of availability. Capital is one of the major limiting factors in protection as well as utilization of forest resources in the developing countries (84).

The economic level of the people has a direct bearing on their current needs. The current needs of masses in the developing countries revolve around grazing of cattle, and fuelwood for heating their hearths. The protective values are in the mind of the forester only. The general masses have detached views of the forest resource, unless, of course, it continues to meet their immediate needs. If a forest is in the custodianship or use of an individual or a clan, it might be protected and, in some cases, regenerated. In the under-developed societies the ignorant individuals, who happen to be in majority, have little sympathy with the

public forests. They will endeavor to overuse a piece of forest for economic reasons, even by stealth or connivance with lower forest officials.

With full developmental process, the masses might get enough education and opportunities to relieve the present burdens from the forests. Such a stage might arrive when adequate alternative sources of livelihood are available to the people.

Political and Administrative Limitations

The resource use policy decisions are greatly influenced by pressure groups (73, p. 2). There is always a conflict between individual and group interests, local and national interests, conservation and economic interests and interests of political groups which are based on immediate exigencies. A majority of the developing countries are in a political turmoil. The minimum stability in political and administrative machinery needed for firm resource use decisions is absent in many countries. Political instability leads to administrative slackness, which, in turn, adversely influences the maintenance and development of resources. Forestry as a long term enterprise requires continued stability in administration. Where this is found lacking, the forest community is likely to deteriorate.

Pakistan's Kala Chitta Protected Forest and Murree Hills forests are heavily burdened with public rights of grazing and extraction of forest produce. With the increase in population, the number of incumbents has also increased. Bashir Ahmad wrote in The Working Plan of Murree-Rawalpindi Forests (West Pakistan), in 1961:

> . . . The harmful effects of overgrazing were realized by Pigot in 1888 who wrote that grazing was heavier than the forest would support . . . the quantity of timber demanded by right-holders far exceeds the annual yield which any forest, however well stocked and scientifically managed, could produce. . . . Finally, an increase of cultivation within the protected areas, while placed under certain restrictions, is not limited in extent under the rules . . . with increase in population the demand for firewood (and timber) by rightholders has increased tremendously. Continuous heavy grazing not only inhibits the reproduction, but also affects the brushwood in the forest. . . . The trees are lopped for firewood, cones are swept from the forest floor and cut off from the trees. . . .

This is not an isolated instance. Similar situations prevail in most parts of the under-developed countries, except perhaps in Far Eastern Asia and uninhabited parts of Africa and Latin America. A firm political, legislative and administrative action under a rationally prepared rehabilitation plan could possibly save the forests which are undergoing deterioration.

Discussion

The populations of the developing countries are increasing more than are their net economic growth. The forest resources are not only decreasing spatially, but also qualitatively. The gamut of opportunities for economic expansion is limited because of shortage in adequate technology, capital and skilled workers. Therefore, pressure on land resources, especially forest resources, is persisting. The masses have a traditionally aggressive attitude towards the forest resources (60). The political machinery in many countries, living from crisis to exigencies, willfully permits the misuse in order to prolong its life by winning the sympathy of the ignorant masses. A large number of developing countries have a shortage of planning and managerial organizations, which inhibits progress even if conditions conducive to development exist.

Many under-developed nations have realized the immediate urgency of these problems. The urgency of the reversal of deterioration of resources is being given serious thought, as is evident from the Report of the Lagos Conference (79) and National Reports of F.A.O. (55). The flow of technology from the comparatively developed countries has provided the necessary impetus. Most of the developing countries have initiated integrating forestry in their overall development programs. It is being realized that in view of the great magnitude of problems facing these countries, the use and management pattern of the forest resources need re-orientation. One possible way of achieving this objective is through the application of multiple use forest management. Before examining the possibility of its application in the developing countries, the foundation on which this form of management is based should be discussed so as to determine whether it is stable enough to endure the conditions prevailing in the developing countries.

SECTION III

MULTIPLE USE FOREST MANAGEMENT

Multiple use, according to Connaughton (19), connotates a concept rather than a method or system of land use. McArdle (48) believes that multiple use involves an organized combination of uses and services of forest land for realization of optimum values consistent with the objectives of management. Forest land is capable of yielding more than one value. The incumbent society, no matter in what state of economic development, would endeavor to derive all possible benefits from the forest land. The state of use of the resource in a given society will depend upon natural physical factors, the extent of development carried out by man and the socio-economic conditions of the society. The function of a wise resource use policy is to ensure best use of soil, capital and manpower (69). The question of forest resource use policy in the ultimate analysis rests on the value or values held by the society. The society may either give priorities to one of the physical, economic or social values, or combine them in a balanced order to obtain optimum satisfaction (69). This combination of values is the gist of multiple use management.

Multiple use is not an assemblage of single uses. It involves integration of forest land uses for human welfare in the largest meaning (42). It seeks and secures the dedication of each unit of forest area and the resources thereon to a combination of uses for which it is best suited; it aims at producing in perpetuity those economic and social

values which will contribute to the greatest net public good (24). Multiple use concept, therefore, involves the forest, the land upon which it grows and the people dependent upon the resource as a whole. This would mean (81, p. 1, Sec. 4):

> The management of all the various renewable surface resources of the (national) forests so that they are utilized in the combination that will best meet the need of the American people; making the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; that some land will be used for less than all of the various resources; and harmonious use and management of the various resources, each with the other without impairment of the productivity of the land, with consideration being given to the relative values of the various resources, and not necessarily the combination of uses that will give the greatest dollar return or the greatest unit output.

According to Evans (24, p. 1028):

> Multiple use is a concept of management . . . that envisions the trees, the soil, the water, the forage, the wildlife, the scenic . . . values . . . all as elements which must have their proper place and weight in the management pattern and plan.

A unit of forest area has to be managed in such a way that optimum values are obtained for the incumbent society. In multiple use management, the society and the resources are considered interdependent. The welfare, growth and productivity of both are inter-related.

The Forest Service Manual (80, Pt. 2100-3, 1963) defines multiple use in the following words:

> 1. The deliberate and carefully planned integration of various uses so as to supplement each other as much as possible, and to interfere with each other as little as possible.
>
> 2. The skillful adjustment of land resource and uses into a pattern of harmonious action to achieve overall objectives for the area being managed.
>
> 3. The coordination of existing and potential uses and activities with a resultant benefit to people that is greater than the sum of the individual uses if they are not coordinated.

Assumptions and Uncertainties

The element of uncertainty is fairly significant in resource use decisions. The future needs and wants of the society cannot be precisely predicted, nor what the technology will produce in terms of substitutes, and to what extent the people would want them. The future resource values, therefore, cannot be specifically determined. According to Morris (52, p. 3), the highest economic and social use value of the land is not always known. The element of uncertainty is also predominant in technological developments and their acceptance by the society (15, pp. 475, 493). It, therefore, becomes obvious that the resource values and decisions should be determined within the framework of these limitations.

This element of uncertainty has led to certain assumptions which constitute the cornerstone of multiple use management (80, Amend. No. 10, 1963). It assumes that:

a. The productive potential of the forest land is fixed. According to the Manual, ". . . it is based . . . on satisfying the needs of the people within the capability of the site rather than the full development of the resource." This assumption loses ground when environmental and natural inputs are supplemented with artificial inputs, such as irrigation (forest plantations in Pakistan) and fertilization (pulpwood forests in Sweden), in order to enhance productivity. The supplementary inputs may increase economic yields from the forest, but do not necessarily usher in a change in social outlook towards the resource. The enhanced productive level of the resource would call for a system of management which would produce increased social and economic returns, and at the same time, help maintain the productivity at the enhanced level of perpetuity.

b. The demand for outputs of forest land is increasing with the increasing population. The Forest Service Manual (80, Pt. 2100-4, 1963) says:

> The need for application of this concept to land management has increased because of limitations in space and land resources. So long as there was a surplus of resources, the problems of coordination were simple or non-existent. However, demand for use of resources is becoming intense and there is little doubt that demands will continue to grow.

The human population is increasing at a rate of 1.7 per cent (2.7 per cent in the developing countries). The productive potential of the land is not increasing proportionately (29). Since expansion in areas under forest cover is practically limited, a feeling of scarcity of resources is being generated all over the world. According to McArdle (49, p. 145):

> . . . multiple use helps to overcome the problem of scarcity. It tends to reduce or resolve conflicts of interest and competition for resources. . . . it impedes the ascendency of single-interest pressures. It promotes balance of use.

Multiple use, according to Connaughton (19), secures a complete use of the forest land which is made significant by the increasing population.

c. The single use management* is incapable of meeting the demands of the society. The Forest Service Manual (80, Pt. 2100-4, 1963) says:

> . . . Land managers are constantly confronted with demands to segregate units within which a single resource use would be given major consideration or exclusive priority. Such demands will increase as requirements for resources grow, and as various interest groups become aware of possible future changes from methods of operation to which they have become accustomed. The National Forests and their resources are not adequate to fully satisfy these individual desires for space and other resources.

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*A forest is under single use management when it is exclusively maintained for one purpose. For instance, the forest of the City of Frankfurt is maintained only for watershed protection (47).

The philosophy of single use management is questionable (49, p. 143):

> There are a few countries in which production is limited to timber alone. It is in fact by no means certain that specialized single-purpose land use, particularly on permanent basis, is ideal. In some social and economic environments, such specialization would certainly not help towards reaching the desired goal of deriving maximum yield from the land for the benefit of the community as a whole.

Single use forestry is not necessarily in accordance with the economic and ecological principles. It might become necessary under special circumstances (certain southern California forests for watershed values), but it certainly does not meet the total needs of the society. The multiple use, therefore, is capable of yielding higher overall social and economic values (17, 19, 49).

In view of these assumptions, such actions as would ensure stability in management and yields in an 'uncertain' future are needed. The Manual (80, Pt. 2100-4, 1963) says:

> It requires an analysis of the inherent capability of land to produce a sustained yield of several resources and services without impairment of the site. . . . It requires conscious planning and management. . . .

Analysis of the productivity of the site, good planning and intensive management are essential requirements of the multiple use concept.

Socio-economic Values

The current resource use pattern is determined by socio-economic pressures (22). The needs and wants of the society determine the nature and extent of the dominant use. The phenomenal increase in the recreational use of the forests in the United States of America is an abundant proof of socio-economic control of resource uses. The evolution of the

concept of multiple use management in itself is a result of the guidelines set by social and economic values created in a society moving towards prosperity. These guidelines have been responsible for a change of outlook towards the forest resources from a romantic-sentimental phase to the utilitarian phase (9), from where it is moving towards a complex inter-relationship between people and resources. In an affluent society like in the U.S.A., the social demands sometimes over-weigh the economic considerations. According to Lana D. Leopold, quoted in Scarcity and Growth, by Barnett and Morse (3):

> . . . We must be willing to stand and assert that there are some things which we as a nation want, but which in purely economic terms would be described as valueless or sheer luxury. To preserve such values it may be necessary to decide a-priori that we want them and assign them a high priority without attempting to put a price tag on the benefit received. If we want a particular canyon, a rare species of bird, or a particular valley preserved because of its scenic beauty when threatened by some other use, strictly economic comparisons will seldom result in its preservation. The reason for this is that we have not found, and in my opinion we should stop looking for ways of placing a dollar value on scenery, on recreation, and on that intangible mental well being which we associate with beauty. . . .

Thus, the society wants the enjoyment of beauty even if it costs something to them. If the society does not possess alternative resources to readjust burdens of use, it might have to live without aesthetics, or determine ways and means to create a balance between goods and services attainable from the forest resources.

The primary objective of the forester is to meet the social and economic demands of the people. It is evident from the following quotation (9, pp. 3-4):

> . . . The objective of public management is to maximize the returns to society over time (italics added). The solution involves a complicated interplay of physical, social, economic and political forces involving different time preferences and

> facing different degrees of uncertainty. . . . Natural resources are considered to be a part of the social capital which provides the flow of goods and services on which our level of living depends. Man's need continues over time, and the unique objective of public management is to provide this flow of goods and services to meet present as well as predictable future needs.

In defining the objectives of the multiple use management, the Manual (80, Pt. 2102, 1963) proposes:

> . . . establishment of a pattern of land uses and resource development that conforms with changing conditions and public needs . . . integrating management activities so that each contributes to the others for optimum efficiency and public benefit.

Ecological Basis

The purely economic exploitation of forests sometimes results in the deterioration of the resource. The ruins of Harappa and Mohen-Jo-daro in Pakistan, and those of the Tigris and Euphrates civilization in Iraq provide an abundant proof of the fact that violation of natural principles of resource use lead to disaster (30, 34). Man is capable of manipulating the ecosystem, but unless it is done in conformity with the requirement of the habitat, it will invariably lead to deterioration of the ecosystem. In the words of Billings (7, pp. 132-133):

> . . . Because of the holocoenotic nature of the environment and the corollary situation of trigger-action, man can manipulate the whole ecosystem for his benefit. With even less difficulty, he can let them get completely out of hand, to the detriment of both present and future generations. In a modern, crowded and touchy world, a knowledge of ecosystem interactions, trends and possibilities is absolutely necessary to our future well being. . . .

The forest must be conceived as an assemblage of biotic, edaphic and climatic forces which coexist and interact in a state of equilibrium at specific locations on the earth's surface. The productive capacity of the forest is subservient to these biophysical interactions (36). The forest ecosystem units must be defined as significant, comprehensive

segments of the forest land spectrum (62). Since neither land nor forest alone can indicate the nature of ecosystem, any management pattern should be based on both biological and environmental factors and forces. According to Hills (36, pp. 572-75):

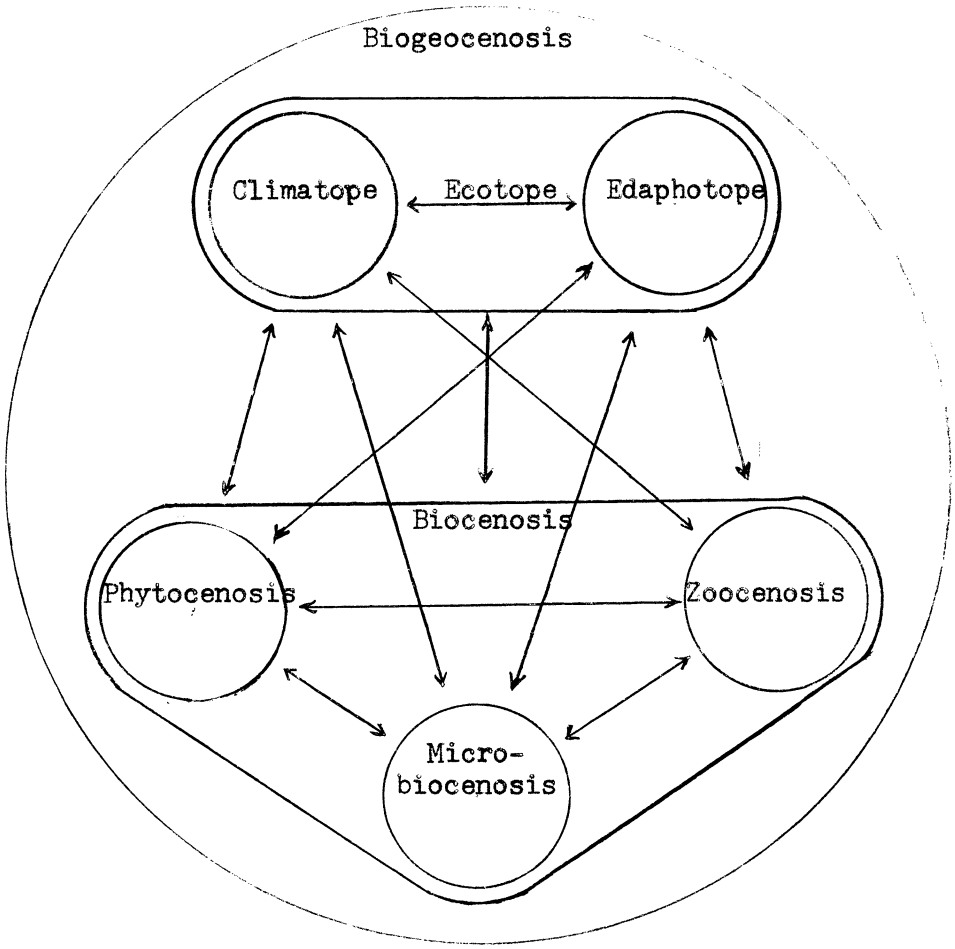
> The object of forest management is to manipulate the various features of the forest ecosystem in order that the potential of each forest area may be as fully utilized as possible within the limits imposed by economic and social conditions. . . .

The basis of forest management should, therefore, be ecological as well as socio-economic. Man is both modifier and an important part of the ecosystem. The manipulation of the ecosystem should be such as to serve the legitimate human needs, and also maintain the dynamic process of formation, development and perpetuation of the productive capacity of the habitat.

Sukachev (65) has proposed that the natural conditions of forest management and economic considerations should constitute the basis of forest management. According to Morozov (51), the biological, climatic, edaphic and hydrological factors are interrelated. The forest and the medium in which it grows are deeply interrelated and interdependent. The totality of biological and physiogeographical characteristics of the forest community should be given a significant weight in the context of management. The biogeocenology, according to Sukachev (65), or biocenosis, according to Morozov (51), or ecosystem, according to Tansley, should be given consideration in determining the form of forest management. This basis of forest management was recommended by the Ninth International Botanical Congress held in Canada in 1959 (65). In accordance with biogeocenological characteristics of the forest communities, the U.S.S.R. forests have been divided into natural domains, zones and

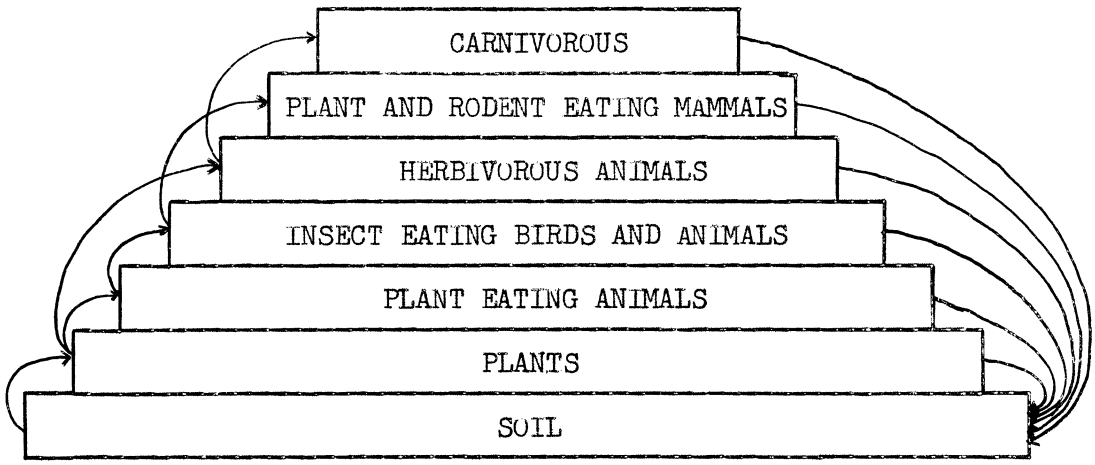
districts in order to form a solid base of forest manatement (51, 65). The interrelations between components of the biogeocenosis is given in Diagram No. 3.

Diagram No. 3. Interrelationships in Biogeocenosis.



Leopold (44) has proposed the Biotic Pyramid showing the interrelationships of various elements of what he calls the biota. This Biotic Pyramid is shown in Diagram No. 4. The biota as a whole is useful to man, when it is economically manipulated. Economic manipulation of the biota creates disturbance in the balanced relationships existing

Diagram No. 4. Biotic Pyramid



between various components. The man-made disturbances are more drastic than those created by natural causes (44). Elements of the biota differ in tolerance of disturbances. When the disturbance increase beyond certain critical limits, the changes occurring in the ecosystem become irreversible. The less violent the man-made changes, the greater the probability of successful adjustment in the pyramid. The violence varies with the density of human population and intensity of his needs (44).

Man's needs and wants have increased tremendously in extent as well as nature. Their effect on forest resources cannot be restrained. The management should, however, attempt to create a balance between ecology and economics (72). According to Lutz (46), the ecosystem tends toward a dynamic equilibrium in which violent fluctuations in the physical environment and biotic components are less likely. The fluctuations should create serious disturbances in a static balance, but nature is neither static nor stable. A static equilibrium--the final state--is never achieved. There is, therefore, a possibility of amelioration of ecosystem to serve the human needs (44). Lutz suggests that in practical

forestry, drastic changes introduced in biotic or abiotic components should remain under constant surveillance by the manager so that a harmony is maintained between natural and human influences.*

Equilibrium and Disequilibrium

Nature is dynamic and tending towards attainment of equilibrium, which according to Lutz (46) is never achieved. According to this school of thought (8, p. 4), ". . . the natural equilibrium on the whole is not attainable within any reasonable planning period," and that the usual condition of "natural world is disequilibrium. . . ."

The evolutionary process is dynamic. At a given moment of time there is a balance between various components of the ecosystem. The object of management should be to utilize the resource without causing irreversible changes. An ecology-oriented manager might subordinate his techniques to natural elements and adjust the uses to suit the ecosystem. Multiple use in this case becomes a static concept (8), and will not serve the changing needs of a dynamic society. Alternatively, if the concept of disequilibrium is accepted the resources will be valuable only if they meet the human needs (8). In the latter case, the management should be such that it produces the needed goods and services with the known technology by manipulation of the ecosystem. Multiple use management is a compromise between the two. It is "the harmonizing of forest uses to secure optimum values to meet the needs of the people

* In periods of drought, for instance, grass growth decreases. If man's livestock continues grazing at the same rate as in rainy years, there is a likelihood of the deterioration of vegetation. The adverse effect of the severe winters of 1885-1886 and droughts of 1933-1935 on vegetation and livestock industry in the western United States is an instance of disharmony between nature and man.

. . . without impairment of the site." (17, p. 3). It is decidedly better than the maximum economic exploitation of the forest, and is better than making the use pattern subservient to the ecosystem. Maximum economic exploitation of forests can be achieved either by totally exhausting them, or by scientifically mining them. The latter will involve intensive forestry practices on lands where fertility is maintained by artificial inputs, such as irrigation, fertilization and use of hybrids. On a small scale irrigation (Pakistan's irrigated plantations), fertilization (Swedish pulpwood plantations) and hybrids (Italian hybrid poplar) have been employed, but their application on an extensive scale is limited because of physiographic, economic and technological reasons. The scope of "orchard forestry" still seems to be limited. The concept of multiple use suits the "naturalistic" as well as "orchard" silviculture (46, p. 405):

> Naturalistic silviculture is based on the principle that a forest in the long run can satisfy economic and other requirements only when the relationship between stand, site, and entire plant and animal world exists in harmony. . . .

In orchard forestry, which is based exclusively on economic principles, "the yield capacity of the site is maintained and improved, if necessary, by artificial methods. . . ." The multiple values of the forest can be perpetuated in both systems under multiple use management. The Changa Manga Irrigated Forest in Pakistan, which is the oldest irrigated, man-made forest in Asia, is used for timber production, grazing, wildlife perpetuation, recreation and production of other forest values. Though these uses are not harmonized under multiple use management, yet they are an illustrious example of feasibility of multiple use management in "orchard" forestry. According to Jeydev (39, p. 481):

> Whether it is a natural forest . . . a forest raised under orchard conditions, the fact should be kept in mind that the forest is a living entity which should be in harmony with nature. The basic principles of silviculture remain the same . . . the forest . . . should be managed with a long range view and with a full understanding of the function of the forest, its economic objectives, and its contribution to human welfare. . . . Forest management should continue to be on the basic principle of sustention. . . .

These objectives can possibly be attained with multiple use management rather than single use management.

Productive Potential of the Land and Multiple Use

In multiple use management, the determination of the productive potential of an area is of primary importance. The manager must know what values a particular tract of land is capable of producing. The inclusion of any area into a particular use-pattern depends upon its natural capacity and limitations. This aspect also depends upon the objectives of management and needs of the people.

The concept of resource use within the framework of biological productive potential of land was known to the ancient sages. Theophratus (30, pp. 30-31) wrote in 300 B.C.:

> . . . that each tree seeks an appropriate position and climate is plain from the fact that some districts bear some trees but not others; and that, even if they obtain a hold, they do not bear fruit . . . even in a world so changed by man as ours has been, land use operations can profitably relate to the pattern of vegetation which originally clothed the earth, and it is frequently to the advantage of man to keep this relationship in mind. . . .

The management of the forest resources should rest on recognition of the fact that the productive capacity of land varies from place to place according to the soil, vegetation, slope, exposure, climate and other physical factors. According to Graham (30, p. 11):

> With due regard to prevailing economic conditions, the use of any parcel of land should result in the yield of that crop which can be most profitably produced without permanent injury to the physical capacity of the land.

This concept is the foundation stone of the multiple use management. While outlining the objective of forest management in the United States of America, Secretary of Agriculture James Wilson wrote to Gifford Pinchot (59, p. 180):

> . . . In the administration of the forest reserves it must be clearly borne in mind that all the land is to be devoted to its most productive use for the permanence of the resource (italics added) for the permanent good of the whole people.

The multiple use management thus considers the capability of land to yield various products, and endeavours to adjust uses so that the permanence of the resource is ensured. This is further backed by the Multiple-use Sustained Yield Act of 1960, Section 4(b), which says:

> Sustained yield of the several products and services means the achievement and maintenance in perpetuity of a high-level annual or regular periodic output of the various renewable resources of the national forests without impairment of the productivity of the land.

Multiple use management requires the analysis of the inherent productive potential of the forest resource to yield several goods and services on a perpetual basis without impairment of the resource (24). It seeks to delineate areas of comparable productivity qualitatively and quantitatively, considering the land as a permanent resource. The intensity and extent of uses are subject to adjustment and revision in accordance with the production level of the area and socio-economic pressures. The multiple use management has enough flexibility to eliminate cropping from protection forests, and for the continuous readjustment of uses in productive forests (80, 81, 82). The forest lands of Ontario, Canada,

have been classified on the basis of their productive potential in order to seek adjustment of various uses (36). This has been done in order to ascertain the inherent capability of a piece of land to satisfy certain needs. The lands capable of yielding more economic returns under agriculture have been classified as such. The forest lands have been classified according to their potential to yield different products and services. Some areas, for instance, have been considered suitable for timber production, the other uses being subordinate to it. If a land is incapable of producing timber, it has been excluded from the timber producing zone.

Evolution of the Concept

The forest resources in almost every country of the world are used for more than one purpose. The traditional forest uses are timber, fuelwood, forage for livestock, wildlife, water, numerous minor forest products, and more recently, outdoor recreation. To varying degrees, these uses are prevalent to the extent which an existing culture demands within the framework of economic conditions. Single use forestry is uncommon, with the exception of forests exclusively maintained for special purposes, such as nature reserves, watershed reserves, etc.

The multiple use forest management is an ideology peculiar to forestry in the United States, and is synonymous with the U.S. Forest Service. Of late, however, it is being adopted by Bureau of Land Management, State Forestry Departments and private forest owners in the U.S.A. and some other countries.

Multiple use has variously been defined. Connaughton (19, pp. 1-3) has defined it as:

> . . . an organized combination of uses or services of the land in such a way that realization of all the values is obtained consistent with managerial objectives. . . . The uses and services are combined in a manner that they are complementary insofar as attainable.

Hardy Glasscock (85, p. 11) of the Society of American Foresters has defined it as "the harmonizing of forest uses so as to maximize the benefits." Title 2101 of the Forest Service Manual (80, 1958) says:

> Multiple use management is the willful adjustment of land resources and uses into a pattern of harmonious action to achieve overall objectives for the area being managed. Resources and uses may complement one another. Frequently, they are in conflict. When conflicts occur they must be resolved by prescribed action to secure agreed-upon subordination of one use to another.

R. M. Evans (24) defined it as:

> . . . a principle or statement of purpose, it is susceptible of definition in simple terms . . . that envisions the trees, the soil, the water, the forage . . . the wildlife . . . the aesthetic values . . . the people . . . all as elements which must have their proper place and weight in the management pattern and plan.

Multiple use is, therefore, a method and a system of land use. It is also a principle or philosophy of forest resource use which developed with the American economic and social system. It embraces the needs and wants of the people, and endeavors to meet them on economic and ecological bases of forest land use. This principle illustrates the close relationship between people and resources, and is reflective of American economic, cultural and political patterns.

At the time of its inception, the U. S. Federal Government did not possess any land. Between 1781 and 1802, the original thirteen states turned their unoccupied lands to the Federal Government. This was the first public domain land. It was further augmented by the Louisiana Purchase of 1803, the annexation of Southwest Territory in 1846, Florida

Purchase, Texas Purchase and the Gadsden Purchase. This land, measuring about 1442 million acres became the basis of land use policy in the U.S.A.

The first attempt to dispose of this land under legislative action was by sale, primarily for the purpose of collection of revenue. The Homestead Act of 1862 reflected the failure of the sales system and attempted to dispose of the land by free grants. This Act was further revised, to make it more acceptable to the people, in 1909 and 1916. The School Free Grant Acts were enacted in 1852 and 1962 under which about 86 million acres were given to the educational institutions. These legislations and procedures failed to specify the pattern of land use and extent of holdings, which to some extent resulted in misuse of land in many parts of the western United States.

An early attempt towards conservation of resources was made in 1878 under the Free Timber Act, which sought to regulate the use of timber by the public. In the same year the Timber and Stone Act was passed practically for similar purposes. Free use of forests, trespass, squatting and misuse of land remained widespread till late 19th century. Carl Schurz (Secretary of Agriculture, 1877) laid stress on law enforcement and protection of natural resources. Effective control on land use was initiated by Bernard E. Furrow during his period as Secretary of Agriculture. In 1891, the first forest reserve was set aside by President Harrison under Act of March 3, 1891. During the administrations of Cleveland, McKinley and Theodore Roosevelt, further additions were made to this rapidly growing area. By 1934 the area of forest reserves exceeded 200 million acres.

The Act of June 4, 1897, recognized timber and water production as important forest uses. This made up the deficiency of the Act of 1891, which did not attempt to define any forest use. The Act of 1897 constitutes the first conscious attempt towards the formulation of forest policy in the U.S.A. In his address to the Congress, Theodore Roosevelt said (59, p. 180):

> The fundamental idea of forestry is the perpetuation of forest by uses. Forest perpetuation is not an end in itself; it is a means to increase and sustain the resources . . . and the industries which depend upon them. . . . The forest resources will be of greater uses in the future than in the past. . . . Their usefulness should be increased by a thoroughly business like management. . . .

This was a well defined objective of forest policy in the U.S.A. The forest reserves were transferred to the Department of Agriculture in 1905 under the Act of February 1, 1905. In 1907, National Forests were created in place of forest reserves. Secretary of Agriculture Wilson wrote to Gifford Pinchot (59, p. 261) in 1905:

> In the administration of the forest reserves, it must be clearly borne in mind that all the land is to be devoted to its most productive use for the permanent good of the whole people. . . . All the resources of the forest reserves are for use. The permanence of the resources of the reserves is indispensable. You will see to it that the water, wood and forage . . . are conserved and wisely used. . . . The continued prosperity of the agricultural, lumbering, mining and livestock interests is directly dependent upon a permanent and accessible supply of water, wood and forage. . . . The dominant industry will be considered just, but with as little restrictions to minor industries as may be possible. . . . When conflicting interests must be reconciled the question will always be decided from the standpoint of the greatest good of the greatest number in the long run. These general principles will govern in the protection and use of the water supply, in the disposal of wood, in the use of the range and in all other matters connected with the management of the forest reserves. . . .

This statement of objectives recognized the multiple values of the forest, the need of their permanent perpetuation, the resolution of

conflicts in uses and recognition of the right of the people on the national resources. This, then, is the foundation of the multiple use management which was raised on the principle of "the greatest good of the greatest number in the long run." The recreational use of the forests was recognized in the Lease Law of March 4, 1915, which permitted the erection of summer homes in scenic areas. R. Y. Stuart, Chief of the Forest Service, wrote in 1928 in a memo:

> The importance of recreational use as a social force and influence must be recognized and its requirements must be met. Its potentialities as a service are definite and beyond question. Its rank in national forest activities will in large degree be a major one . . . as a recognized form of use of natural resources it should receive the same relative degree of attention and planning that is now given other forms of utilization. . . .

The Act of June 22, 1933, provided for the establishment of wildlife sanctuaries and recognized the importance of wildlife in the national forest system. Thus, the traditional five cornerstones of multiple use concept--water, wood, forage, recreation and wildlife--were legally recognized as natural uses of forests, and were incorporated into the management pattern. The Chief of the U.S. Forest Service, R. E. McArdle (48) said in 1955:

> Millions of people will continue to insist on having these products and services (grazing, recreation, wildlife, timber, water) of the national forests. They can get them best through a system of multiple use management. . . .

Conflicts and Resolution

When a unit of biological entity is put to more than one use, conflicts usually arise. The conflicts may be between grazing of domestic animals and big game, between recreation and timber production, between watershed management and timber production, and so on. Multiple

use aims at simultaneous use of various resources with the condition that the conflicts are reduced or eliminated for the purpose of ". . . harmonizing of forest uses to secure optimum values to meet the needs of the people." (17). The resolution of conflicts is of basic importance in multiple use management. The compromises made in this manner tend to create a concurrent state of equilibrium. The Forest Service Manual (80, Pt. 2101) says:

> The objective of multiple use management is to make the national forests "the permanent good of the whole people" and to resolve conflicting interests to best serve "the greatest good of the greatest number in the long run."

and again, in Chapter 2110:

> The objective of multiple use coordination requirements is to resolve or prevent conflicts between two or more competitive resources, uses or activities in the same area.

The resolution of conflicts requires the analysis of the capability of the site to produce sustained yield of several services. It needs conscientious planning and management. Many uses and services of the forests are compatible, such as water production and recreation. Others can be made compatible through modifications in intensity, place or time of operation. Multiple use is applicable to large areas. Therefore, the adjustment of uses by modification in intensity, place or time offers little problem. According to the Manual (80, Pt. 2100, 1958):

> . . . Multiple use is generally applied to a large area such as a ranger district, national forest or watershed. It is a misconception to think of multiple use as being applied acre by acre. There is no conflict with the principle when, as usually happens, more than one resource or use is obtained on an individual acre to a single resource or use is a perfectly logical multiple use procedure. In applying multiple use, the first step is to decide upon land management objectives. . . . On private land objectives may be most strongly and properly influenced by profit considerations. On public land, full use designed to meet overall public needs may or may not be tangible in terms of income. As land use becomes more intensive, management objectives must be clearly set

> forth in order to make multiple use management successful. . . . If all resources can be used to a maximum without conflicts, the ultimate in multiple use management is obtained. However, such full use is rarely possible under intensive management. A harmonious combination of resources and uses to arrive at maximum overall benefits from the land usually requires some modification in individual uses. . . . In applying the multiple use principle, the land manager is faced, therefore, with reconciling conflicts in such a manner that overall objectives are reached. . . . Objectives are best accomplished by securing the highest degree of multiple use management that the characteristics of the land will permit. . . .

These objectives are attained by applying a set of coordination requirements which aim at elimination of conflicts. The coordination requirements appear in the form of prescriptions in the management plans, as stated in the following passage of the Manual (80, Pt. 2103, 1958):

> (a) application of multiple use coordination requirements in all resource management, protection and development activities
>
> (b) preparation of regional guides for multiple use planning based on analysis and evaluation of resources and uses
>
> (c) preparation of ranger district multiple use plans based on regional guides
>
> (d) preparation of resource management functional plans and project plans based on ranger district multiple use plans.

Diagram No. 5. Compatibility Scale in Forest Resource Use. (Modified from Taylor, 67, p. 48)

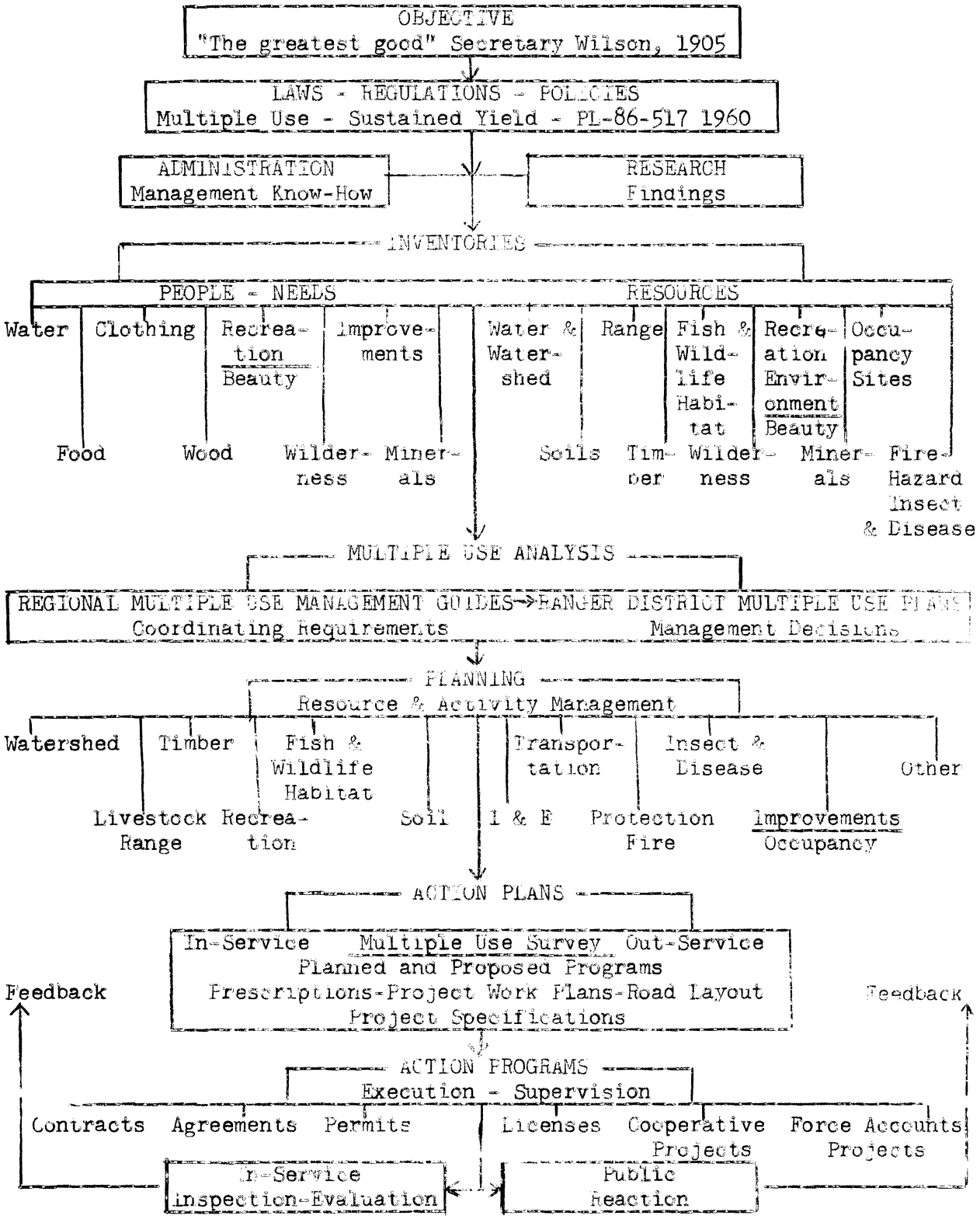
Primary Forest Land Use → / ↓	Recreation	Timber	Grazing	Water	Wildlife	Mining
Recreation	High	Moderate	Moderate	High	High	Low
Timber	Moderate	High	Moderate	Moderate	Moderate	Moderate
Grazing	Low	Moderate	High	Moderate	Low	Moderate
Water	High	Moderate	Moderate	High	High	Low
Wildlife	High	Moderate	Low	High	High	Low
Mining	Low	Moderate	Moderate	low	Low	High

The regional guides lay down the basis of reduction and elimination of conflicts and give a framework within which compatibility of uses is achieved (80, 81, 82, 83). This objective is attained by analysis of each unit, planning and adequate administration. The sequential process is shown in Diagram No. 6. The compatibility of uses is sometimes obtained by zonation (81, 82). The administrative area is divided into management zones on the basis of compatibility of uses, productivity of the area and management objectives. For instance, the Intermountain Region is divided into 18 National Forests and one National Grassland, covering an area of 32 million acres. This vast tract includes a wide variety of biotic, edaphic and physiographic conditions. Based on these conditions and peoples' needs, the Region has been divided into a number of management zones for which the management directions and coordination requirements are contained in the Regional Guide (81, 82). The following zones are recognized in this region:

(a) Crest zone. This consists of major water producing, subalpine and alpine elevations. The main uses are water production, recreation such as hiking, riding, fishing and hunting. This zone is not used for wood production, but some grazing may be permitted for short periods.

(b) Intermediate zone. This is the main timber producing zone. It is a major refuge for wildlife, and grazing ground of domestic livestock. Generally, it is located between Crest zone and the arid Lower zone. Its main uses are timber production, grazing, wildlife, water yields, recreation and mining, where compatible and feasible. Economically, this is probably the most important zone and comprises the bulk of the national forests.

Diagram No. 6. Planning for Multiple Use Management on the National Forests.



(c) Lower zone. This is low, rolling country with semi-arid to arid climate and shrub and grass as main vegetation types. It is important both for livestock and wildlife. Water production may also be significant in certain cases.

(d) Travel Influence zone. This includes areas of varying width along the travel routes. It may occur in any or all of the above zones. Its main use is recreational and aesthetic. Timber production and grazing are eliminated from this zone where necessary, or considerably reduced to maintain the scenic outlook of the area.

(e) Water Influence zone. This zone comprises areas of varying widths along rivers, lakes, reservoirs and streams. Its utility is the preservation of recreational characteristics of the areas bordering water bodies. Timber production, grazing and other uses, if feasible, are carried out or eliminated if not feasible.

(f) Special zones. These comprise areas or uses not covered by the above mentioned zones.

The regional management guides provide instructions for the "analysis of the resources, uses, and activities as they relate to the present and future needs . . ." and establish management directions and coordination requirements for each zone (80, Pt. 2120, 1967). The definition, characteristics and management pattern for each zone is prescribed in the regional guide (80 Pt. 2121, 1967).

The objective of zonation is the maintenance and protection of the productivity of the land, and at the same time create "a harmonious integration of use, the aggregate of which is greater than a non-integrated sum." This could be achieved, as mentioned earlier, by

conflicts of uses in each zone. The guidelines are flexible to enable the manager to choose between:

(a) Simultaneous use of the forest for products which are or have been made compatible.

(b) Limited use of some areas, as in the Crest, Travel and Water Influence zones.

(c) Sequential arrangement of uses over time to minimize conflicts, such as grazing in recreational areas in winter or fall, or rotational summer livestock grazing in winter game areas (80, Pt. 2100, 1967). The ultimate objective is to obtain optimum values from the management unit by integrating all possible uses according to the capability of the land. The optimum combination of uses in a particular area will vary with the ecology of the site, socio-economic needs of the people and their future needs and wants (17, 25, 26). This objective may also be achieved by determining the dominant use for the particular management unit in accordance with its potentiality and the market demands, and subordinate other uses to the dominant use. The priorities of the subordinate uses will be determined by their ecological and socio-economic importance (12).

Discussion

The multiple use concept is based upon ecological and cultural considerations. For its ecological considerations, it endeavors to perpetuate the resources and obtain multifarious products on sustained-yield basis. For its cultural reasons, its objective is to provide maximum social and economic satisfaction to the people. The socio-economic values are subject to change. The wants of the people also change with

time. Since resources and people cannot be separated, the wants of the people must be satisfied. The multiple use management has the adaptability to cater to changing needs and wants. If society wants only fuelwood and forage, these goods must be supplied to the society. The perpetuation of the resource, however, must be insured. An advanced society, which possesses substitutes and alternatives, might want to maintain the forest for recreation, wildlife, watershed and grazing. The planner and the manager have to find the management cues from the market trends and social conditions.

Single use forestry, on the other hand, is based on rigid foundations, and while stressing one resource value, neglects the other values. While single use forestry may yield maximum economic returns at a given time or over a period of time, it cannot withstand periodic economic instability. According to Shirley (63), multiple use forestry can ameliorate economic instability significantly. According to Vaissiere (69), the efficiency of land as an economic producer increases under multiple use management. A forest under single use management may possibly give more economic returns so far as that particular product is concerned. This may be true over a short period, unless artificial inputs are used to maintain fertility. If, however, a piece of land being used for one purpose, say timber, is also used for forage, wildlife, honeybees and so on, an additional money return will accrue from it, provided such combined uses are not in conflict. This is a very significant reason for adoption of this concept in the developing countries.

Champion (14) has questioned the validity of multiple use concept on the basis that interaction of two or more uses over prolonged periods cannot be ascertained in a reasonably short period. If this view is

accepted, then the best use of the forest can possibly be "no use," because the action of a single use on the biogeocenosis is also not known (65), nor is the interaction of biological communities within an ecosystem fully understood (8). Champion (14) has proposed that alternative uses for agriculture and forestry, as practiced in forests of India and Pakistan, or under taungya system, may economically yield more returns. This practically amounts to sequential adjustment of uses over time, which is not uncommon in multiple use management. If we elaborate on Champion's concept further, the phase in which land will be under forestry use cannot be termed as a single land use. Obviously, there will be more than one use in this phase.

Single use forestry becomes necessary under certain special circumstances. The evergreen chaparral forests of California are maintained primarily for conservation reasons. The forest of the city of Frankfurt, W. Germany, is managed only for watershed values (47). Nicholas (56) has challenged the single use management of Ozark National Park, on the basis that multiple use can render more social and economic services than single use. Under such circumstances where one use has an overriding importance, Carhart's concept (12) of dominant use may be adopted. The workability of this concept is well explained by Cooper (20) who has cited the example of the Salt River watershed in Arizona, where water production is predominant over all other uses. Kreutzinger (42) points out that in Poland, wood production is the primary objective, while the rest of the uses are subordinate to it. Mann's contention (47) that in an industrialized area, multiple use is not practicable does not hold good, as is evidenced by the examples of the U.S.A. and Canada.

The applicability of multiple use management to wildlands and

nature reserves is not only feasible, but also imperative (56). According to Motovilov (53), nature protection in U.S.S.R. is not a passive preservation. It means carrying out a system of diverse actions directed toward preserving, restoring and expanding natural wealth and regulating its use. Nature protection in Russia is an economic and scientific activity, and, therefore, a multigarious use. In a country where forestry has to be a part of the total economic picture (70), multiple use is imperative even in so-called nature reserves or national parks. The intensive use of wildlands in Europe is proverbial (38). According to Jeffers (38), the intensity of use is determined by geopolitical maturity of an area and availability of technology and organization. As long as the northwestern parts of the U.S.A. had space and resources, and lacked manpower and organization, it was a wildland. Its settlement and inclusion into the national economy has changed its status from a wildland to an important economic entity. According to Merriam, as quoted by Jeffers (38):

> . . . that the forests and forestry are not unlike democracy, not merely something to be defended and preserved, but an ideal to be developed and enriched.

The human needs and wants have changed from individualistic, personal and family to group, community, national and the whole human race. Such a change warrants for intensive and extensive flow of goods and services from forests (38). The exclusive reserves, therefore, should give way to productive forest entities; more so in the developing countries.

About 23 per cent of the world's forest area is privately owned (84). Profit motivation determines the type of management in private forests; the exclusion of public rights from the private forest lands has a limiting effect on the applicability of multiple use management

on private lands. However, Orell (57) believes that multiple use is practicable with all its benefits in private forests, provided the priority of the highest use is defined in context of the prevailing market conditions. Some large land holding companies, such as Weyerhaeuser's or Anaconda, are in a position to provide free recreational facilities to the public (38). Clawson (16) believes that recreational use of the private lands is likely to increase in the U.S.A., especially in the northeastern United States, where it might become a major use of the private forest lands. In a society which thrives on free enterprise, multiple use on private forest lands is not only practicable, but also brings in greater returns to the owners (57).

Thus far it has been discussed that multiple use has its origin in the belief that the productivity of the land is limited, that forest land is non-expandable, and that there is an increasing demand for forest products and services. We have also discussed that single use management is unable to meet all the multifarious needs and wants of a changing society. Multiple use management is broad and flexible enough to meet the needs of a present day society, and cater for the future needs also, even if changed, by readjustment of spectrum and scale of uses. It is ecologically and economically sound. Its administration is feasible. It can be applied to special purpose areas, such as national parks, game sanctuaries, watersned reserves, and to private forest lands. Its economic efficiency creates stability in the market. Over 60 years of successful application of this concept in the United States and Canada has proved that this system can be profitably applied in a progressive society and it is capable of keeping pace with the technological, cultural and economic development.

SECTION IV

APPLICATION OF MULTIPLE USE IN DEVELOPING COUNTRIES

Basic Assumptions

The human population in the developing countries is increasing at an average rate of 2.7 per cent. It will double in an estimated period of 26 years. The increasing population is creating complicated problems for these countries. One of these problems is an increasing pressure on the forest land resource. According to Glesinger (29), the forest area has been shrinking at a faster rate in the past 100 years than ever before. More and more forest area is going out of production either as a result of misuse or clearance for agriculture. At the same time, the demand for forest products is increasing. The consumption of industrial wood between 1913 and 1955 has increased from 150 to 240 cubic meters in South America, from 40 to 50 cubic meters in Africa and from 50 to 90 cubic meters in Asia (29, p. 192). In this period the world population rose by 20 per cent, while the consumption of wood increased by 33 per cent. The consumption of wood between 1955 and 1965 recorded an increase of 18 per cent in South America, 22 per cent in Africa, and 13 per cent in Asia (78). According to the F.A.O. estimates, the developing countries will experience a phenomenal increase in demand for forest products in the near future.

The economic progress in the under-developed countries is disproportionate to the rate of their population growth. As a result, there is little apparent increase in the economic level of the masses.

Consequently, the pattern of life is changing very slowly. If this rate of real progress persists, the majority of the masses of these countries is likely to continue to subsist on grazing and agriculture in the near future. There is a need for the creation of stability in grazing practices, and bringing them under sound management.

There has been some progress in raising forest plantations of fast growing species, especially in India, Israel and Pakistan (55), but the achievement is small compared to overall requirements of forest products. There is an insignificant likelihood of more productive areas being taken out of agricultural use for afforestation. It can safely be assumed that the productive potential of the forest lands cannot be raised substantially by any means other than better silviculture and management. Extensive use of hybrids and fertilizers in forestry does not seem to be forthcoming in the near future.

The variety of demands for forest products is also increasing in the developing countries. The demands for industrial wood products has increased faster than that for firewood (55, 78). The F.A.O. reports (55) show that hunting, fishing and recreational use of forest areas is increasing in the developing countries. There is also an increased awareness of watershed values of the forests. For instance, watershed rehabilitation work has been initiated in the vast watershed of River Indus and its tributaries (41):

> . . . an area of 34,625 square miles was surveyed wherein it was found that most of the forests, rangelands and farms in the catchments of Indus and its tributaries in West Pakistan are suffering from moderate to severe erosion. Scientific management of the hilly catchments . . . is necessary for prevention of floods and for saving and extending the useful life of reservoirs, hydro-electric installations, barrages and canals in the Indus Basin.

Appreciation of this problem is becoming more and more apparent in other developing countries. Rao (60, p. 153) says about the watersheds of India:

> The aridity of these regions has been increased by deforestation. These areas were densely clothed with woods. . . . Their cooling moisture-conserving effects must have been of immense value to cultivated land between blocks of forests . . . and . . . now innumerable gullies and ravines are constantly annexing more domain at the expense of fertile lands.

Recreation and propagation of wildlife is also gaining importance. For instance, F.A.O. (55, p. 3) said in 1964:

> Countries such as . . . India, Pakistan, Thailand . . . have further progress to report in the field of National Parks, wildlife conservation and recreation, particularly in the creation of more sanctuaries. . . .

The Lagos Conference (79, p. 24), sponsored by U.N.E.S.C.O. in 1964, being fully conscious of the need of preservation of flora and fauna of Africa, passed a resolution stating:

> Recommends, finally, that plans for the <u>wise</u> exploitation and utilization of natural resources, and in particular renewable resources, should not use up more than the capital which they represent and can produce and that, consequently, they should include measures for the conservation of natural resources, fauna and flora.

We can conclude by assuming that a pressurized situation exists in the developing countries in respect to forest land. At the same time, numerous forest values are being appreciated and there is an increasing awareness of the necessity of introduction of a rational and workable management pattern which could help restore the depleted areas and maximize the flow of goods and services from the forest land. As Rao (60, p. 153) says in context of the forest resources:

> . . . as in many other spheres, it is through conscious and thoughtful effort that humanity has to work out its salvation by releasing itself from the shackles of ignorance, superstition, and aggressive traditional attitudes, the continuance of which is obviously suicidal.

Rao (60) and Glesinger (29) believe in the feasibility of application of multiple use in the developing countries.

Problems and Hinderances

The application of a new technology in a society which is still endeavoring to stand on its feet is beset with problems and complications. The application of multiple use management will involve certain serious changes in socio-economic values and attitudes toward resources, which might make a segment of the society doubtful or even shy of the new concept. What is immediately needed in the developing countries is a "conscious and thoughtful effort" to release the society from "traditional attitudes." According to Glesinger (29), the foresters should not be mere "conservators" in such countries, because the need for higher quantity and quality of forest products is increasing. There is, therefore, a necessity of introducing a better form of management to meet the increasing social and industrial demands. The inherent capability of a developing society to provide the premium mobile, induction mechanism and entrepreneurship is probably a vital and significant factor which facilitates absorption and introduction of new concepts in these countries.

Shifting cultivation. Shifting cultivation is a common use of forest land in the developing countries. According to Bedard (6, p. 2016):

> It must be admitted that the existence of this practice under uncontrolled conditions is detrimental not only to forestry, but also to proper land use . . . the long range effect is one of gradual deterioration of land and impaired productive capacity for both forests and food crops. Forest policies in most countries have, therefore, been justifiably oriented towards increasing control on it with a long range objective of its eventual elimination.

Significant progress has already been made in many countries to bring shifting cultivation under control, and use it as a silvicultural tool. For instance, in India and Pakistan, the cut-over area is given to the cultivator who burns the slash, removes stumps, cultivates the land for 2 to 3 years and then plants with trees before moving to the next area. Shifting cultivation on this pattern is more useful than harmful. It can readily be accommodated in multiple use management. Thus, a factor which is considered as a cause of forest land deterioration can be employed as a beneficial use of land under a multiple use plan. Champion (14) suggested a similar pattern without making mention of the possibility of its adjustment in a multiple use plan.

Gradually, the agricultural nomads may be persuaded to settle down in various administrative units of the forests to practice agriculture where feasible in the cut-over areas, and to provide labor force to the forest administration. Since the cultivation will be done under the supervision of the trained personnel, it might be possible to introduce better practices, e.g., use of fertilizers, etc., in order to enhance the yield of agricultural crops and reduce the area under migratory cultivation. If migratory agriculture is integrated with forestry on this pattern, eviction of the cultivators from the forest areas will become unnecessary. This pattern of forest land use, however, can accrue from the multiple use forest management.

Grazing. Grazing is probably one of the most important uses of temperate, semi-arid and arid forests and savannahs of Africa, Asia and South America. It has been the universal cause of forest deterioration. Stebbing (64) and Patterson (58) believe that the main reason for

disappearance or deterioration of forests in Africa and South America is the result of excessive grazing. This situation calls for a better control, technical as well as administrative. It might require such measures as livestock improvement in order to facilitate reduction in numbers. It also calls for permitting grazing in accordance with the carrying capacity of an area. The progress will be slow, but it can be achieved in a reasonable period of time. Mooney (50) suggests:

> In the regions of the high forest and grassland and tropical broad-leaved forest, especially in the more remote and less developed parts where tillage for crops has not yet occupied the land to any extent, the first step should be to set aside suitable areas as forest reserves. Outside these, the natural pastures can be maintained and improved by means of suitable management . . . the whole extensive region covered by the scattered tree-grassland . . . which is unsuitable for agriculture . . . suitable areas in . . . woodlands should be permanently reserved . . . to provide fuel, wood for construction . . . to the local people.

Mooney suggests a scheme of forestry - grazing - agriculture in an integrated form under suitable management. One way of achieving suitable management can be multiple use, which can help decrease grazing pressure from the over-burdened areas, utilize the less used areas and rehabilitate the deteriorated lands along with the continuous production of other values. Multiple use concept recognizes the economic and social importance of grazing on forest lands. The problem of grazing in the forests of developing countries cannot be solved by outright eviction of graziers. Perhaps the feasible solution is to introduce stringent control on the number of livestock in accordance with the carrying capacity of the grazing units. Rotational or deferred grazing should be practiced in order to enable the vegetation to recover. Side by side, a program of livestock improvement should be pursued vigorously. These measures can not be taken in a haphazard manner. If visible results are desired,

actions should be taken under integrated plans, as is done in multiple use management.

Political and administrative stability is necessary for the introduction of some long-range reform program in forestry. Din (23, p. 227) says:

> Political and administrative upheaval and instability leading to loss of efficiency and morale . . . have plagued several countries. . . . In some countries this has been further worsened by either breakdown of law and order or outbreaks of insurgency in the countryside, which paralyzed forest operations and made forest management virtually impossible.

Trained personnel. Strong administration is necessary for multiple use management. This is another weak point in the forest management situation of under-developed countries. Shortage of adequately trained personnel is almost chronic in some countries, such as Afghanistan, Saudi Arabia, Mauritiana, Mali, etc. (55, 79). The U.N.E.S.C.O. Conference at Lagos (79, p. 24) suggested:

> . . . in view of the extreme shortage of scientific and technical personnel in most of the countries, there should be a general mobilization of all possible means in order to cope with this shortage. . . . The highest priority should be accorded to the teaching of the various scientific disciplines at all levels . . . campaigns should be systematically organized in each country with a view to drawing the attention of the people to the essential role which . . . technology and science can play in solving the social and economic problems . . . to raise the material and spiritual standard of living. . . .

Similar urgency is developing in Asian countries (55). The governments are attaching great importance to the technical training, including forestry. The inflow of technical knowledge from the advanced to the developing countries has tremendously increased during the past 20 years. In the foreseeable future, the shortage of technical personnel will no longer remain a problem. The forestry education and training programs

in the developing countries have gained new momentum after World War II. The F.A.O., U.N.E.S.C.O., Colombo Plan and the concerned agencies of the developed countries, especially those of the U.S.A., Canada, U.S.S.R., England, W. Germany, etc., are making appreciable contribution towards over-coming the shortage of trained personnel.

New Trends

Some Asian countries have taken legislative or administrative steps toward introduction of planned management on the basis of multiple use concepts. The following excerpts from the F.A.O. National Progress Reports (55) show the current tendency:

Indonesia: The national forest policy and forest law recognizes the multiple values of forests. The objective is to "intensify the utilization of forests . . . by applying the multiple use principles as far as possible."

India: The forest policy "aims at evolving a system of balanced and complementary land uses under which land deterioration will be the least." The Forest Act of 1927 is being reviewed by the Central Board of Forestry for submission to Parliament for amendments to bring it in line with the policy statement.

Pakistan: The forest policy statement of 1954 recognizes the multiple values of the forests. There is, however, no effort to revise the laws according to the policy statement. Watershed management, wildlife and recreation are gaining importance in forest management.

Malaysia: The forest policy declares that the forests will be managed for "the maintenance of the climatic and physical conditions, safe guarding water supplies and soil fertility . . . and perpetual supply of forest produce. . . ."

Philippines: The Administrative Code declares that the forests would be maintained in the public interest, perpetually in productive condition by wise use. New divisions of wildlife and watershed were created in 1956 and 1963, respectively, within the Bureau of Forestry.

Hong Kong: The policy statement aims at "vigorous protection of vegetation within all catchment areas, whilst recognizing the need for multiple use--for forestry, nature, conservation and recreation."

Langsdale-Brown, Omaston and Wilson (26), in their comprehensive report on land use-vegetation relationship in Uganda, have vigorously opposed "the unwitting destruction of these resources by the ruthless application of 'economic' techniques of land use." They suggest that the land should be used according to its potential, and according to what it can produce without deterioration, which is very much the foundation of multiple use concept. The Lagos Conference (79) of U.N.E.S.C.O. and Organization of African Unity laid heavy stress on the necessity of ensuring the perpetuation of fauna and flora of Africa, which "under the present conditions . . . are not systematically used."

It is obvious that the developing countries are becoming aware that their forest resources are not being wisely used at present. An increasing tendency towards integrating various uses is developing in these countries. Unconsciously or consciously, most of the developing countries are moving towards a phase where they can adopt the multiple use management. Provided these countries can overcome the problems of shortage of trained personnel, instabilities of politics and administration, and their traditional aggressiveness towards their resources (60), multiple use management can effectively be applied. It cannot be said precisely how long each country will take to overcome the problems of resource use. Circumstances vary from country to country, as do the individual efforts to achieve socio-economic progress. A fair majority of the developing countries, as discussed previously, have the conditions conducive to the application of multiple use management. According to

Hirschman (37, p. 4), the economic (and social) progress of a nation depends upon the will of the people to develop and their spirit of entrepreneurship, which "has seldom been found wanting in a society favourable to its exercise." As was seen in the discussion of conceptual model of technological adaptability (Diagram No. 2, p. 30), a handsome percentage of developing countries have an atmosphere conducive to acceptance of new workable ideas. Such countries can profitably adopt the multiple use management.

The following quotations are appropriate and sum up the situation and reflect the necessity of introduction of a wise forest policy, like the multiple use management:

> We are thus led to the conclusion that for a number of well-known reasons forest output, especially in underdeveloped countries, is not progressing at the rate which appears desirable and even needed. Unless this situation changes . . . many countries . . . are bound to experience three equally serious difficulties in their development process. These are: first, that inadequate supplies of paper, building timber and other forest products will act as a bottleneck in achieving better living standards and raising national incomes; second, that even the artificially reduced amounts of paper, timber and so on, which will have to be imported, will act as an increasing serious drain on currency reserves which should be directed instead to the purchase of capital goods; and third, this growing shortage of forest products will lead to increasing over-exploitation and destruction of accessible forests. (29, p. 194).

and:

> I believe that one day our soil and our forests from one end of the country to the other will be well managed, and our supplies of water will be abundant and clean. I believe that there will be an abundance for all as God and Nature intended; an abundance properly distributed when man has the wisdom to understand and solve these things. I believe there will be no more floods to destroy the things man has worked to create and even man himself. . . . (60, p. 156).

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